Safe Food, Fair Food project

Participatory epidemiology: Dairy value chain assessment in eight villages in Tanzania

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Acronyms and abbreviations

CBPP          Contagious bovine pleuropneumonia
CAHW          community-based animal health worker
ECF           East Coast fever
FGD           focus group discussion
FMD           Foot and mouth disease
ILRI          International Livestock Research Institute
LFO           Livestock Field Officer
LSD           Lumpy skin disease
PE            participatory epidemiology
PP            proportional piling
SFFF          Safe Food Fair Food
SUA           Sokoine University of Agriculture
TFDA          Tanzania Food and Drugs Authority
TZX           Tanzania shillings
Acknowledgements

I wish to extend my sincere thanks to Dr Anna Sikira the team leader, Dr Amos Omore (the principal investigator of the More MilkIT project) of the International Livestock Research Institute (ILRI) and Prof Lusato Kurwijila, the Irish Aid More MilkIT Project Country Coordinator and the country coordinator for the Safe Food, Fair Food project in Tanzania of Sokoine University of Agriculture (SUA), for their continual communication and advice during field work.

Great thanks to the Safe Food, Fair Food project team (Delia Grace and others) and the BfR team (Alexandra and Juliane) for comments which added to the report more scientific sense. The exercise would not have been possible without the support from Prof Germana Laswai of Sokoine University of Agriculture (SUA) and Mr Salim Wenner Nandonde who facilitated the farmer groups and advised the team during the study visits in all the eight villages. My sincere thanks as well to all who contributed their comments to the draft report.

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Lastly, but not least, my wife Monica, my daughter Helen and my son Gregory for their continual encouragement as all of them were on a month holiday at home while I was in the field.
Executive summary

The project: The International Livestock Research Institute (ILRI) secured funding from the BMZ/GIZ-funded project Safe Food Fair Food (SFFF2) to pursue specific aims of applying the risk-based approaches to improving food safety and market access in smallholder animal source food value chains in African countries, including Tanzania. The goal of the project is to protect the health of poor consumers and safeguard livestock-based livelihoods of poor livestock keepers and other value chain actors aiming assessing, communicating and managing food safety risks in five value chains as part of an integrated program for transforming smallholder production and productivity.

The study focus: The study focused on identification of practices/factors with potential of public health risks along the different dairy value chains, the critical control points for specific zoonoses/pathogens, the human health illnesses that may be associated with consumption of animal source food (especially milk) in the project sites, the food safety risk mitigation measures, cost of food borne illness, and the capacity building needs with respect to knowledge, attitudes and practices related to risk factors as well as managing risks involved.

Study area: The study was conducted in the two regions (Morogoro and Tanga) of Tanzania represented by four districts, namely, Morogoro (Kilosa and Mvomero) and Tanga (Handeni and Lushoto). These sites were previously identified through spatial analysis, consultation with stakeholders and pre-sites selection scoping study. The districts were selected to represent (a) pre-commercial rural production to rural consumption and (b) relatively more commercial rural production to urban consumption. A total of eight focus group discussions were conducted in the two regions each attended with at least 8 to 10 male and female cattle keepers.

Research team: The interview team was composed of representatives from Sokoine University of Agriculture (SUA) and ILRI and each had their role: facilitator: to ask the questions and lead the discussions; the note taker for detailed documentation of the discussions and the observer to cross check the analysis templates as well as assisting the facilitator if some issues were missed out. In each respective district/village, at least one to two government extension officers’ representatives were as well involved as observers.

Methods: Prior to commencement of the study, all were introduced/trained in the use of the participatory epidemiology (PE) tools to be applied during the interviews. The following PE tools were used during the assessment: pairwise ranking to establish cattle keeping constraints; proportional pilling for cattle exit; proportional pilling for herd morbidity; mortality and case fatalities; disease impact matrix scoring; and open-ended questions to assess animal health services, public health and milk-borne diseases.

Findings: Following the interviews in the eight villages, the team managed to identify the role of diseases in constraining production in both production system and farmers’ knowledge of diseases causation under extensive and semi intensive/intensive production systems. The access to animal health services by farmers which is more accessed under semi/intensive than in extensive production system. The farmers’ knowledge on animal source human health problems which are less under extensive production system comparatively to semi/intensive system and the cultural beliefs that may enhance occurrence of human illness transmitted from the animals found to be high under extensive production system.

Recommendations: The study came up with some recommendations for intervention which will serve to mitigate most of the risks found in the study area for public food safety. The main recommendations are to: (1) strengthen animal health services delivery to enable extensive production systems get better access to more affordable and quality veterinary services; (2) reactivate compulsory vaccination programs to fight against endemic livestock diseases which affects households livelihood especially under extensive production system; (3) establish farmers groups for collective market voice as well as education arena; and (4) conduct further studies to identify potential pathogens and predisposing factors/practices for their prevalence and potential risk factors for transmission from animals to humans and thereafter confirm sources of the identified human zoonotic illness which could be associated with consumption of livestock products mainly milk.
Introduction

This study is a follow up taken as the diagnostic phase to assess dairy value chain (VC) in Tanzania so as to inform what will be the next steps in the three projects namely; the IFAD funded MilkIT project, the Irish Aid funded MoreMilkiT project and the BMZ funded Safe Food Fair Food (SFFF2) project. Diagnostic (value chain assessment) tool kit applied in this phase, have been developed under CGIAR Research Programs on Livestock and Fish (CRP3.7), Agriculture for improved Nutrition and Health (CRP4.3) and on Policies, Institutions, and Markets (CRP2) for use with producers, inputs and service providers and milk traders. The kit has been adapted for application in Tanzania in consultation with Sokoine University of Agriculture and other national partners.

The study methodology used focus group discussions (FGDs) to explore general and specific farmer’s perceptions in the main and specific objectives of the study in Tanzania dairy value chain development. The main objectives were; 1) to characterize the context, and community perspectives of the current situation with respect to dairy production, market channels, actors, and flows of dairy inputs and outputs along the marketing chain, 2) to characterize the possible forms and functions of hubs, by way of looking at producers’ problems and opportunities and identifying key indicators to be factored into the follow-up detailed sites selection for the hubs and baseline survey to address and 3) to identify constraints, barriers to participation by poor men and women, opportunities for value chain upgrading and expansion, and associated risks with particular regard to domains of feeds, breeding, animal health and food safety. All these information will be complement by household level data.

With regards to animal health and food safety, ILRI secured funding from BMZ to implement a project titled “Safe Food Fair Food (SFFF2”) to pursue this aim. The project aims to apply risk-based approaches to improving food safety and market access in smallholder animal source food value chains in African countries, including Tanzania. The project goal is to protect the health of poor consumers and safeguard livestock-based livelihoods of poor livestock keepers and other value chain actors with the expected initial output by the end of 2012 that: Food safety risks in five value chains are assessed, communicated, and better managed as part of an integrated program for transforming smallholder production and productivity. To attain the expected initial output, the study focused mainly at; identification of practices/factors with potential of public health risks along the different dairy value chains, the critical control points for specific zoonoses/pathogens, the human health illnesses that may be associated with consumption of animal source food (especially milk) in the project sites, the food safety risk mitigation measures, cost of food borne illness, and the capacity building needs with respect to knowledge, attitudes and practices related to risk factors as well as managing risks involved. All these were assessed using participatory epidemiology (PE) methods.

Specific objectives

The specific objectives of the study were to:

- assess what role diseases play in constraining production (farmer’s perceptions of the importance of health constraints in relation to specific production parameters)
- facilitate own problem analysis on health constraints (diseases, symptoms or syndromes), elicit knowledge on disease causation (host, environment, pathogen)
- assess animal health services those are accessed and
- assess animal source human health problems
Methods

Sampling and study area

Farmers: The aim was do at least 8 FGDs each consisting of about 8 to 10 male and female cattle keepers across the two regions in Morogoro (Kilosa and Mvomero districts) and Tanga (Handeni and Lushoto districts). These sites were previously identified through spatial analysis, consultation with stakeholders and pre-sites selection scoping study. The PE - FGD consisted of about 8 to 10 participants in all the interviews in 8 villages both gender represented.

Districts: The districts have been chosen to represent: a) pre-commercial rural production to rural consumption and b) relatively more commercial rural production to urban consumption. Within each district, the aim was to randomly select a village that represents the dominant and emerging (if ≥5% of cattle) dairy production systems: extensive/(agro)pastoral, semi-intensive/sedentary and intensive/also sedentary. The first two production system categories mainly have zebu cattle and represented the pre-commercial rural to rural milk market chain while the latter represent improved dairy with commercial rural-urban market chain orientation. That is a total of about 64 to 80 farmers (2 regions x 2 districts x 2 systems = 8 FGDs x 8 to 10 farmers each). The aim was to have a relatively homogenous group of farmers in terms of their production system/breeds during each participatory rapid appraisal. Site profiles and criteria for selection of farmers are given below.

Table 1: Profiles of selected districts

<table>
<thead>
<tr>
<th>Region</th>
<th>District</th>
<th>Cattle population*</th>
<th>% improved dairy breeds</th>
<th>Dominant production system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morogoro</td>
<td>Kilosa</td>
<td>215,100</td>
<td>1</td>
<td>Extensive/Agro-pastoral (zebu)</td>
</tr>
<tr>
<td></td>
<td>Mvomero</td>
<td>187,350</td>
<td>5</td>
<td>Extensive/Agro-pastoral (zebu) with significant semi-intensive &amp; intensive (improved)</td>
</tr>
<tr>
<td>Tanga</td>
<td>Handeni</td>
<td>126,780</td>
<td>1</td>
<td>Extensive/Agro-pastoral &amp; Extensive/Sedentary (all zebu)</td>
</tr>
<tr>
<td></td>
<td>Lushoto</td>
<td>119,492</td>
<td>24</td>
<td>Extensive/Sedentary (zebu) with significant semi-intensive &amp; intensive (improved)</td>
</tr>
</tbody>
</table>

Table 2: Selection of farmers

<table>
<thead>
<tr>
<th>Market orientation</th>
<th>District</th>
<th>Production system</th>
<th>Village</th>
<th>Breed</th>
<th>No. of farmers interviewed</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-commercial:</td>
<td>Kilosa</td>
<td>FGD 1: Extensive/Agro-pastoral</td>
<td>Mbwade</td>
<td>Zebu</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>rural production to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rural consumption</td>
<td></td>
<td>FGD 2: Extensive/Sedentary</td>
<td>Twatwata</td>
<td>Zebu</td>
<td>12</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Handeni</td>
<td></td>
<td>FGD 1: Extensive/Agro-pastoral</td>
<td>Sinden</td>
<td>Zebu</td>
<td>9</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FGD 2: Extensive/Semi intensive</td>
<td>Kabuku</td>
<td>Zebu</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>More commercial:</td>
<td>Mvomero</td>
<td>FGD 1: Extensive/Agro-pastoral</td>
<td>Kambala</td>
<td>Zebu</td>
<td>10</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>rural production to</td>
<td></td>
<td>FGD 2: Semi</td>
<td>Manyinga</td>
<td>Improved</td>
<td>8</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>
A total of 75 farmers were interviewed of which 45 males and 30 females in all systems. All systems were therefore represented by at least two villages: four groups of extensive/agro-pastoral zebu farmers (Mwade, Twatwata, Kambala and Sindeni), two groups of extensive/sedentary zebu farmers (Kwampunda and Kabuku) and two groups of semi intensive and intensive improved breed farmers (Manyinga and Kwangwenda).

During general selection, farmers were randomly selected from a typical village community representing the site production system identified through the local government authority. Using the list of households available from the village secretary or from other sources, cattle keepers were randomly selected using a computer generated list of random numbers. To ensure gender balance selection, households were asked to send a man and a woman alternately; the first household picked was asked to send a man to the meeting, the second household a woman, the third household a man and so on. Random replacements were panned where, for example, a female representative was due for selection but the next randomly identified household was male headed, and vice versa.

Research team composition
The team in each interview session was composed of:

- **The facilitator:** Who explained and guided the discussion and wrote key notes on flipchart for all participants to see.
- **The note taker:** For detailed documentation of the discussions; noted observations during the interview; cross checked the analysis templates and reminded the facilitator about missing issues. The note taker also recorded any controversies in the discussions, contentious issues, how the group made decisions or reached consensus, and any notable differences in responses or discussions between different groups, for example between men and women.
- **The observer:** To cross-check the analysis templates; reminds the facilitator about missing issues. The observer also possibly has to take away dominant members of a group to talk to him/her separately if found to affect the interview process. At least 1 or 2 observers worked in parallel.

Participatory epidemiology tools used
Some efforts were put in getting a feel of some quantitative aspects arrived at through group consensus. The main purpose of the assessment was to identify opportunities for intervention. Some of the findings may need to be triangulated with secondary/key informant/service provider data during the exercise or investigating them further at a later stage. The information on the PE tools is from Ameri et al. (2009)

**Tool:** Pairwise ranking for cattle keeping constraints

**Objective:** comparisons to get more accurate information on relative importance of different constraints.

**Method:** Brainstorming with participants during FGD on the constraints to dairying putting more emphasis on; feeds, disease, markets, improved breeds, production levels, insecurity etc. This was followed by developing a matrix with constraints along the top and side using picture cards.

After listing the constraints, two cards are held up and the participants asked to compare the two constraints – which is the most important? The most important one was written in the relevant box of the table. This was repeated for all combinations of constraints until one side of the table was complete. The constraints were then scored based on the number of times they were ranked as most important. The constraint with the
highest score was ranked highest. Probing questions were asked when the constraints were being compared meanwhile giving the reason of their choice.

Table 3: Pairwise ranking matrix results

<table>
<thead>
<tr>
<th>Constraints</th>
<th>D</th>
<th>LF</th>
<th>LM</th>
<th>DR</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease (D)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of feed (LF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of markets (LM)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drought (DR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others (O)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tool:** Proportional piling (PP) for herd entry and exit

**Objective:** To identify the cattle exit from the community for the reasons none associated or related with diseases as well as assessing community dependent on livestock in their livelihood.

**Method:** A circle is drawn on the ground to represent the community total herd/cattle assumed to be 100. A pile of similar sized stone (counters) is put in the circle to represent all the cattle in the village. The farmers indicate the proportion of all cattle which left the community over the past one year and those which remained. Farmers further divide those left into different exit reasons like; drought, sales, dowry and accident (see below)

![Plate 1: Proportional pilling for cattle exit](image1)

**Tool:** Proportional Piling for morbidity and mortality

**Objective:** To identify the relative mortality, morbidity and case fatalities caused by different diseases in the individual herd.

**Method:** A circle is drawn on the ground or flip chart to represent the individual herd. A pile of similar sized stones (100 counters) is put in the circle to represent all the cattle in the herd. The respondent then divides the herd into two groups: those that fall sick from disease over the past one year and those remained healthy.

![Plate 2: Proportional pilling for morbidity and mortality](image2)
Those that were sick are divided according to the most common diseases (4 to 5). The rest of the diseases/conditions to be grouped under the category of OTHERS. For each disease the relative morbidity and mortality is therefore indicated followed by calculation of the case fatalities for each specific disease.

**Tool:** Disease Impact Matrix Scoring

**Objective:** Assessing from the farmer’s perceptions/experience the impact of different diseases on livelihood benefits derived from Livestock.

**Methods:** Two stages are involved;

1\textsuperscript{st} stage: Listing the benefits derived farmers from cattle and score them using 100 counters

<table>
<thead>
<tr>
<th>No.</th>
<th>Benefit</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Milk</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>Beef</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Cash</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Dowry</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Manure</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Skin</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

2\textsuperscript{nd} stage: The identified diseases during the interview are scored by several parameters (Benefits) sequentially across to construct the matrix

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Score</th>
<th>Disease 1</th>
<th>Disease 2</th>
<th>Disease 3</th>
<th>Disease 4</th>
<th>Disease 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dowry</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manure</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Plate 3: Diseases impact matrix scoring**

Benefits to respondents

It assists the respondents to think more deeply about the impact of different livestock diseases on their livelihood. Lastly, explaining to them the results from the scoring exercise.

Focus Group Discussion

**Objective:** This component involves general discussion using open ended questions to explore farmers understanding on; Animal health services in their area, knowledge of diseases affecting their livestock, public health and the milk borne diseases and other zoonoses.

**Animal health services:** Exploring how often the typical household rearing cattle use drugs, receive treatments and from who and where as well as information about the livestock improvement. Sources were focused around/within the villages, local districts council and mass media. Service providers were focused on either farmers themselves, community elders, formal/informal drug sellers, veterinary officers etc.
Knowledge of diseases: understanding farmers knowledge on the prevailing diseases, the cause agent and management measures.

Public health: exploring from farmers their understanding on the extent of present or absence of human commonly clinical signs/symptoms which could be associated with consumption of improper milk handling.

Milk borne diseases and other zoonoses: exploring farmers understanding on zoonotic diseases in their area and mainly those could be linked to milk consumption.

Plate 4: Milk storage containers

Plate 5: Milk transportation
Results

Mbwade village, Kilosa District, Morogoro

Constraints in livestock keeping
The group identified the main important constraints affecting livestock keeping in the village as water, pasture, markets, animal diseases and diseases (figure 1 annex 1). Water ranked first due to the fact that, during long dry season, farmers always move their livestock for water access and better pastures when water shortage is experienced. Pastures ranked second due to the land pressure in relation to the number of livestock owned. Markets ranked third due to the closure of the milk collection centre, low milk price during long wet season and lack of trustworthy from the collection agent. Animal diseases ranked fourth regardless of the less veterinary services due to the fact that participants reported pastoralist are knowledgeable in diseases identification as well as treatment.

Proportional pilling for cattle exit from the community
Reasons for cattle exit were said to be due to sales, dowry, wild animals (predators), diseases, thieves and other causes like lost during grazing. Figure 2 and 3 annex 1 summarizes the relative proportions of the livestock that exit in the community with respect to the exit reason(s) followed by the pie chart showing the relative percentages of each reason from the cattle exited from the village as follows; dowry (27.77%), sales (22.22%), predators (13.88%), diseases (13.88%), theft (13.88%) and others (8.33%). Dowry for marriage and sales to meet the household’s needs are the most reasons for cattle exit.

Proportional pilling for the herd morbidity, mortality and case fatality
The interviewed key informant mentioned the main livestock diseases that affected his herd over the past one year and lastly the team came up with the relative morbidity, mortality rate as well as case fatalities for the specific diseases in his herd (figure 4 and table 1 annex 1). The epidemic outbreak of foot and mouth disease (FMD) was reported by the participants that; FMD outbreaks has been coming once in a year but this year there has been three outbreaks in the last six month and associated with High mortalities in calves that participant could not give the proportions.

Table 1 annex 1 it is evident from the participants that, the case fatality from ECF is very high followed closely by LSD and CBPP. This could be due to the less veterinary services in the area in terms of the high cost of treating ECF and no proper dipping facilities to fight against ticks. The high case fatalities from LSD and CBPP could be due to farmers with less access to the vaccines and the CCBPP been endemic in the area. The trypanosomosis was ranked comparatively lower by the farmers as he claimed to be easily treatable. However, further probing revealed that, the Leigwanani purchase almost 50 sachets (anti-tryps) monthly and hence this disease may be among the most with great negative impact to his daily household livelihood as it indirectly cost him a lot out of his knowledge. Each sachet cost minimum 500 Tanzanian shillings (TZX) with a total minimum for a specific disease TZX 300,000 per year.

Diseases identification
The participants were able to identify livestock diseases (table 2 annex 1) and they had significantly good knowledge about the symptoms and the causal reasons as they spent most of their time with live stocks as well as carrying out diagnosis and treatment themselves. Following cross checking their understanding, participants were taken through each mentioned disease briefly for them to at least understand the key symptoms and management measures as well as the advisory services to be considered during treatment.
Disease impact in production parameters
Farmers ranked the five [East Coast fever (ECF), lumpy skin disease (LSD), FMD, contagious bovine pleuropneumonia (CBPP) and heartwater] as the most detrimental cattle diseases in decreasing order of their effect on benefits. Farmers listed and scored the benefits before distribution of the benefits to each disease using disease impact matrix score (figure 5 annex 1). The livestock disease with highest impact on the benefits according to the participants were LSD and FMD with equal score followed by CBPP, heart water, and ECF and for any disease related intervention the action priority should be based upon the disease impact matrix score. Four of them, CBPP, LSD, FMD and ECF were as well noted by the Leigwanani during individual herd proportional pilling for morbidity and mortality.

Animal health services
The village get animal health services like drugs, advisory services and treatment from Morogoro town, cattle primary markets in Kilosa district (Mbwade, Parakuyo, Ngaiti and Kivungu) and Melela cattle in Mvomero district. The services are provided by drug seller (cattle keeper with experience in treating their own livestock though without formal training in livestock treatment) and the distance is generally ranging from 1 to 58 kilometres to source the veterinary services.

The average population and breeds of cattle in the community
The participants enumerated their stock size and breed (table 3 annex 1). From the participant’s response, the dominant breed kept in Mbwade is Tanzanian Short Horn Zebu.

Public health
The participants mentioned the following symptoms as common in the community: fever, vomiting, diarrhoea and coughing. They further, identified the following milk borne diseases; tuberculosis, brucellosis, Rift Valley fever and typhoid fever. The zoonotic diseases identified were rabies, tuberculosis, anthrax, Rift Valley fever and brucellosis. The general symptoms they mentioned for milk and waterborne diseases were abdominal pain, diarrhoea, vomiting, fever, malaise and coughing. They however associated climatic change to many diseases upsurge.

Other diseases mentioned which were neither zoonotic nor food borne (cross cutting) were malaria, HIV/AIDS and surua (measles). Malaria and fever were hard to distinguish among them so they generally referred to fever as malaria, it is possible that fever may include brucellosis, malaria, FMD and typhoid fever. It was further reported some occurrence of carbuncles in human which could as well be associated with presence of anthrax.

Milk borne diseases and other zoonotic diseases
Disease knowledge and practices
Most people consume raw milk and raw milk products like Mtindi as well as consumption of ruminal juice and drinking raw blood, these are practices that increase risks of infection with pathogens and spread of zoonoses if the consumed fresh blood is from subclinical sick animal. Anthrax cases were reported and normally experienced in health cattle with sudden death. The participants also mentioned close contact with animals which equally increase the risk of tuberculosis. Hi level of E. coli in the ruminal content may be normal flora in livestock but not in human.

There is a belief among cattle keepers that due to hard work they do they end up suffering from malaria, tuberculosis and other fevers. The culture of eating dead cattle without knowing the cause of death to the impact on their health especially with the habit of pastoralist to undercook meat may predispose them to high risk of contracting zoonotic diseases.
Consumption of ruminal contents juice as a treatment for malaria and inducing vomiting in sick people may be associated with the occurrences of typhoid and or other infections (needs further investigation) like diarrhoea and vomiting in the population. Some farmers drink fresh milk from their own herd as well as from others herds; this increase the risk of milk borne diseases as not all households pasteurize milk before consumption.

**Twatwata Village, Kilosa District, Morogoro**

**Constraints in livestock keeping**
The group identified the following as the main important constraints affecting livestock keeping in the village whereby, the pair wise ranking (see figure 1 annex 2) gives the constraints findings. Pasture/feed was ranked as the highest constraint followed by water, market, drugs and finally diseases. The group cited general inadequate of pastures, water and markets for their livestock as well as the high cost of the drugs. Disease was not very important since every farmer claimed to be ‘expert’ in diagnosing and treating livestock though the issue of drugs quality and availability was reported as a problem.

**Proportional pilling for cattle exit from the community**
Reasons for cattle exit were said to be due to theft, dowry, sales, drought, home consumption and predators. Figure 2 annex 2 summarizes the relative proportions of the livestock that exit in the community with respect to the exit reason(s) followed by figure 3 annex 2 the pie chart showing the relative percentages of each reason for the cattle exited from the village. The exit reasons and proportions in brackets were; theft (3), dowry (10), selling (12), drought (8), consumption (4) and predators (3) respectively. Selling to meet the households needs ranked first, followed by dowry for marriage, mortality due to drought, consumptions during ceremonies and lastly theft and predation by wild animals.

**Proportional pilling for the herd morbidity, mortality and case fatality**
The interviewed key informant mentioned the main livestock diseases that affected his herd over the past one year (ECF, trypanosomiasis, CBPP, FMD, anthrax and others) and lastly the team came up with the relative morbidity, mortality as well as case fatalities for the specific diseases in his herd as shown in (figure 4 and table 1 annex 2). The high case fatalities from others (66.7%) was reported to be due to sudden death from unknown causal agents, snake bite during grazing, foreign bodies (plastics) and anaplasmosis. The high cases for CBPP (50%) could be associated with unreliable vaccination programs and inadequate knowledge of handling clinical cases. The ECF (46.7%) was reported to be due to high cost of both the drugs and vaccine while anthrax (33.3%) due to sudden death, trypanosomiasis (28.5%) informant has knowledge of diagnosis and treatment and FMD( 25%) high mortalities in calves.

**Diseases identification**
The participants were able to identify 11 livestock diseases positively with their symptoms namely; CBPP, ECF, heart water, LSD, FMD, babesiosis, rabies, black quarter, anthrax, anaplasmosis and trypanosomiasis as shown (table 2 annex 2). Following cross checking their understanding, participants were taken through each mentioned disease briefly for them to at least understand the key symptoms and management measures as well as the advisory services to be considered during treatment. Information from the participants were compatible with formal veterinary knowledge.

**Disease impact in production parameters**
Farmers ranked the five (CBPP, LSD, FMD, anthrax and trypanosomiasis) most detrimental cattle diseases in decreasing order of their effect on benefits. Farmers listed and scored the benefits before distribution of the benefits to each disease using disease impact matrix score as shown (figure 5 annex 2).
The farmers had the view that no one can accept animal with FMD even if given as gift it will be rejected as it spread fast and brings high mortalities to calves. CBPP ranked highest among the animal diseases with respect to its negative effect to the benefits derived from cattle and hence affects the household livelihood followed closely by FMD and LSD. The anthrax and trypanosomiasis seemed to have less impact to the benefits. This could be due to occurrences of anthrax as outbreaks in foci and the endemic nature of trypanosomiasis in the area which is more used by the farmers. However, trypanosomiasis may be carrying high impact than others due to hidden costs as well as less production from cattle (milk and meat) overlooked by farmers.

**Animal health services**

Respondents informed that there is no health service provider. Animal health services such as drugs, they are accessed from the primary markets mainly (Parakuyo kibaoni- 35 km and Mwade- 25 km) as well as from Morogoro town. The main sources of information on animal health aspects are radio, newspapers, workshops and sometimes from researchers. Vaccination services are done by government in which the pastoralists are asked to prepare the cattle holding ground and pay for some charges like transportation for the vaccinators.

**The average population and breeds of cattle in the community**

The participants enumerated their stock size and breed (table 3 annex 2). From the participants’ responses the dominant breed kept in Twatwata was the Tanzanian Short Horn Zebu.

**Public Health**

The following disease symptoms in human were mentioned by the participants in the FGD in order of prevalence. Fever, painful joints, change in voice, headache, difficulty in breathing and warm breathing, nausea and vomiting. They further mentioned severe fevers, tuberculosis, FMD, brucellosis, rabies and anthrax. Participants noted that, the pregnant women aren’t allowed to drink milk from animals suffering from FMD, as it causes abortion and fever. No vaccination services for dogs because the owners of dogs are not known in the society, hence stray dogs around. Participants pointed out, there was one of the community member admitted in the hospital suffering from rabies. They have good knowledge of tuberculosis and the way it is spread from animals to human and human to human. It was realised that, there is general lack of boiling or filtering of milk in the community. Moreover, those who sieve milk presume that it is safe enough.

**Milk borne diseases and other zoonotic diseases**

It was noted that, the fermented milk prepared in calabashes from fresh milk takes 2 days during wet season and one 1 day during dry season. The livestock keepers consume unpasteurized fermented and fresh milk. It was further established that, they drink fresh blood from cattle (like Mwade village) by mare looking of the animal health without considering the possibility of subclinical cases. This translates knowledge gap of subclinical cases which can result into transmission of diseases from animals to human.

Brucellosis is said to be possibly common following occurrences of abortion in the third trimesters and severe fever in human. However, this is always associated with witchcrafts in the community. Some had no knowledge of possibility of transmission of zoonoses while some eats meat from dead animals without knowing the cause of death accompanied with the pastoralist habit of undercooking/roasting meat. Lastly farmers had no knowledge of drugs withdraw period and hence consume livestock products from animals under medication.
Kambala village, Kilosa District, Morogoro

Constraints in livestock keeping
The group identified the main important constraints affecting livestock keeping in the village whereby, the pair wise ranking (figure 1 annex 3) gives the constraints findings. The constraints affecting livestock in Kambala village in decreasing order of their impact in livestock are; 1) land 2) bush burning 3) pasture 4) animal diseases 5) water and 6) markets. Due to land pressure from crop production and livestock keeping, crop producers used to burn the crop residues after harvesting (rice straws) and maize so as to prevent pastoralist from grazing in the cultivation farms. The intentional burning most of the time fire spreads into communal grazing lands which worsen pastures availability hence frequent conflicts among the two parties. It was further reported that, there is influx of people into the village purchasing land for other purposes rather than livestock keeping leading to land shortage. This was said to be the closeness of the village to Morogoro municipality as the town is now expanding.

Proportional pilling for cattle exit from the community
Reasons for cattle exit were said to be due to selling, dowry, penalty (punishment) and ceremonies. Figure 2 annex 3 summarizes the relative proportions of the livestock that exit in the community with respect to the exit reason(s) followed by figure (3 annex 3) pie chart showing the relative percentages of each reason from the cattle exited from the village. From the exit, cattle sales contributes the highest at 46.3%, followed by dowry 26.8%, cultural ceremonies 17.1% and penalty contributed to 9.8%. Selling highest as most of them depends on livestock for their daily household livelihood, dowry is their cultural practice for marriage, ceremonies like circumcision and weddings and lastly penalty which carries less weight.

Proportional pilling for the herd morbidity, mortality and case fatality
The interviewed key informant mentioned the main livestock diseases that affected his herd over the past one year and lastly the team came up with the relative morbidity, mortality as well as case fatalities for the specific diseases as shown in the figure (4 and table 1 annex 3). From figure 4 and table 1, it is evident that, morbidity from FMD is very high followed by ECF, CBPP, Babesiosis and LSD. Similarly, FMD causes high mortality compared to other diseases in the area; however, babesiosis leads to high case fatality followed by CBPP. High mortality from FMD was explained to be the sudden death in calves where as for the adults suffering for a long time end up in developing heat intolerance syndrome.

Diseases identification
The participants were able to identify (table 2 annex 3) livestock diseases positively with their symptoms; CBPP, LSD, FMD, Babesiosis, ECF, trypanosomiasis, anaplasmosis and black quarter. Following cross checking their understanding, participants were taken through each mentioned disease/condition briefly for them to at least understand the key symptoms and management measures as well as the advisory services to be considered as the withdraw period for the drugs they normally use.

Disease impact in production parameters
Farmers first listed and scored the benefits before distribution of the benefits to each disease using disease impact matrix score as shown (figure 5 annex 3). From the findings, CBPP is the most disease affecting the livelihood benefits derived from cattle in the village followed, LSD, FMD, ECF, Babesiosis, black quarter and trypanosomiasis in decreasing order.
Animal health services
Animal health services like drugs, advisory services and treatment mainly are obtained from the village livestock officer who lives and work in the village. The livestock keepers were assertive that each of them is an expert in livestock health for his livestock herd, ‘kila mtu ni daktari wa mifugo yake’ as the art of treating animals is passed from father to son during childhood and when he get his herd he is expected to be knowledgeable enough in livestock diseases diagnosis and treatment. The farmers also get veterinary services from agro vet located in Morogoro town and the primary livestock markets (Mkongeni cattle market).

The average population and breeds of cattle in the community
The participants enumerated their stock size and breed as shown (table 3 annex 3). The dominant breed in Kambala is Tanzania Short Horn Zebu.

Public Health
With exception of one lady in the group, the rest said it is impossible to get disease from animals or vice versa. The lady mentioned tuberculosis that can be through milk consumption. Common human conditions mentioned by the respondents were; malaria, asthma, flue, coughing, tuberculosis, fever, diarrhoea, vomiting and weakness. According to the frequency of occurrence the participants have ranked these conditions in the decreasing orders as follows: fever, malaria, diarrhoea, tuberculosis, vomiting, flue, coughing, asthma and weakness. Fever ranked first because in every conditions they mentioned, it starts with the fever first then followed by other conditions. Then the weakness ranked the last as after the condition one will fill weak during the recovered stage.

Milk borne diseases and other zoonotic diseases
Knowledge and practices
The participants mentioned that many people still consume raw milk, ruminal juice (emoyoo), raw milk products-yoghurt and fresh blood from live animals. This implicates the inadequate knowledge and practices which may enhance risk of communicable diseases from animals to human in the community. Majority of the community reported that, they do not boil milk as they said they have been using it for many years without casualties. To avoid getting disease like tuberculosis, few of them filters (see below) the milk followed by boiling though some believe on filtering only. Filtering was said by the participants but observed at the collection centre.

Manyinga village, Kilosa District, Morogoro

Constraints in livestock keeping
The group identified the main important constraints affecting livestock keeping in the village whereby the pair wise ranking (figure 1 annex 4). From the figure 1, the major constraint in livestock production is milk
market as it was mentioned three times and hence ranked the first followed by dairy breeds, diseases and pastures the last but not the least. Market for the milk score higher because most of the society in Manyinga village does not have the culture of drinking milk and as well there is no cooperative for selling the milk produced by the livestock keepers. Dairy breeds were reported to be due to unreliable artificial insemination services leading to the use of bulls (natural mating). This could as well be linked into low milk production 2 to 3 litres per milking due to inbreeding. Diseases ranked the third due to the fact that, farmers are always in contact with the Livestock Field Officers (LFOs) and hence easy access to veterinary services while pastures the fourth as always available with only inadequate of quality knowledge.

Proportional pilling for cattle exit from the community
The different reasons for livestock exit from the village were mentioned by the participants as through sales and dairy cow debt cycle repayment. Figure (2 annex 4) summarizes the relative proportions of the livestock that exit in the community with respect to the exit reason(s). The biggest livestock exit route was cattle for pay back department followed by sales. The main livestock exit was identified as sales (4%) while the debt cycle repayment (85%) are said to exit with however that, they remain in the same village. The debt cycle repayment is the dairy cow distribution in the village by Heifer Project International system whereby interested villager, receive heifer from the project as a debt with agreement to repay back two heifers in the initial calving succession. The paid heifers are distributed to other villagers who are interested in keeping dairy cows.

Proportional pilling for the herd morbidity, mortality and case fatality
The interviewed key informant mentioned the main livestock diseases that affected his herd. It was noticed that, this particular participant, practices most of routine/required managements to his cattle herd (six dairy cows) as spraying against ticks and biting flies, de-worming and vaccinations. He was as well knowledgeable in treatment against trypanosomiasis using trypanocidal formulations. Due to the said management system, for the past one year there was no cases of sick animals in his herd as shown (figure 4 annex 4). Following these findings, the disease relative mortality and morbidity were not calculated.

Diseases identification
The participants were able to identify the livestock diseases (table 1 annex 4) although they had less knowledge about the symptoms and the causal reasons as they depended mainly on the livestock field officers to identify and treat the disease cases after reporting. Following cross checking their understanding, participants were taken through each mentioned disease/condition briefly for them to at least understand the key symptoms and management measures as well as the advisory services to be considered like the withdraw period for the drugs that LFO has used in treating their sick animals.

Disease impact in production parameters
Farmers ranked the five most detrimental cattle diseases in decreasing order of their effect on benefits derived from cattle as shown in the disease impact matrix score results (figure 5 annex 4). The most challenging disease affecting the benefits derived from keeping cattle is ECF followed by anaplasmosis, trypanosomiasis, mastitis and helminthiosis.

Animal health services
The participants were anomalously for the view that veterinary services are available and accessible both from the local agro vet shops and village livestock extension/field officer. They have village livestock field officer’s phone number who responds promptly when called upon and has a vaccination and de-worming schedule for the area. The most common channels of getting news on livestock health are seminars and
Sokoine University researchers who come once in a year. Person to person information exchange is also common avenues of information sharing since the farmers are organized in group.

The average population and breeds of cattle in the community
For the community we have discussed with during interview sessions, the data given for the number of cattle own by the household were correct. However, the type of breeds provoke the need for the transect walk for verification at the nearby household. Following the transect walk, main breeds are Friesian and Ayrshire filial 2 in regression (see the 15 days calf photo below) which is F-2 following artificial insemination compared to the 5 years cross bred Friesian horned bull found in the nearby household.

The participants enumerated their stock size and breed as shown (table 2 annex 4). The dominant breeds in the village are the exotic crossbreeds.

Public Health
The participants were aware of diseases that can be transferred from animals to human whereby they knew about; tuberculosis, rabies, Rift Valley fever and typhoid fever. They further elaborated that in 2007 one cow died from Rift Valley fever and the public health officials did not allow them to eat the carcass. There are many cattle abortion but none is typical of brucellosis, since the abortions occur two months after conception and with hardly repeat. However, participants were noted that, even for the abortion in the third trimester, to be reported even if it does not occur in the next two or three calving succession. The participants further mentioned the following symptoms as common in the community (in descending order of importance): body weakness, colds, coughs, fever, vomiting and diarrhoea. The ranking was based on the view that due to hard job they do everyone wakes up weak, and because of climatic change colds are common, this leads to chest problems and coughs, fevers which results in vomiting and diarrhoea. Fevers, vomiting and diarrhoea may be associated with salmonellosis, campylobacteriosis and pathogenic E. coli.

Milk borne diseases and other zoonotic diseases
Knowledge and practices
Most people consume boiled milk. Every farmer insisted on practicing hygienic milking practice, with feeding of cats and dogs on milk from cows under treatment till the end of withdrawal period.
Kabuku village, Handeni District, Tanga

Constraints in livestock keeping
The group identified the main important constraints affecting livestock keeping in the village whereby the pair wise ranking (figure 1 annex 5) gives the constraints findings.
Ranking results in order of decreasing importance: 1) breeds 2) animal disease 3) water 4) markets and 5) land. Participants contributed the reasons of their ranking as; lack of good breeds is a big constraint because with good breed one will get enough milk. Animal diseases ranked second owing to high treatment cost and deaths. They all had a consensus that; given good breeds and improved animal health, you can focus then on the markets, water and land for the livestock feeds.

Proportional pilling for cattle exit from the community
Reasons for cattle exit were said to be due to sales, drought, theft and accident and migration (for the extensive) and they are all non-livestock disease related reasons. Figure 2 annex 5 summarizes the relative proportions of the livestock that exit in the community with respect to the exit reason(s) followed by (figure 3 annex 5) the pie chart showing the relative percentages of each reason from the cattle exited from the village.

Sale of livestock for school fees, Medicare, building house contributes significantly to livestock exit and this shows the community dependency on livestock in livelihood improvement. Drought and theft were said to be common leading to loss of approximately 8 and 2 animals out of every 32 cattle exited respectively. Migration was reported from some farmers who shifted to other villages while accidents are due to the location of the village close to the main road to Dar es Salaam.

Proportional pilling for the herd morbidity, mortality and case fatality
The key informant mentioned the main livestock diseases that affected his herd over the past one year and lastly the team came up with the relative morbidity, mortality as well as case fatalities for the specific diseases as shown in figure 4 and table 1 annex 5. Figure 4 represents the extensive production system. A-E represents the number of cattle that suffered from anaplasmosis, ECF, trypanosomiasis, helminthiosis and other disease, whereas, F-J represents proportion of cattle that died from the respective diseases respectively.

It was realized that, diseases that affect the two systems are different. The extensive system is affected mainly by tick borne diseases, trypanosomosis and helminthiosis while the semi intensive system is mainly affected by mastitis (the group consisted of 2 representatives from each production system). This could be due to their closeness to the LFOs hence easy access to veterinary services by semi intensive and the number of livestock kept compared to extensive system that are comparatively marginalized. Trypanosomosis ranked comparatively lower by the farmers. However, the low impact of trypanosomosis may be due to the spraying of cattle against the biting flies.

Anaplasmosis has high fatality due to farmers less knowledge of early detection. Mastitis was said to have high morbidity rate due to less number of livestock kept under semi intensive. However, recovery was reported to be 100% and hence no mortalities though may have indirect negative effect in terms of reduction in milk production.

Diseases identification
The participants were able to identify (table 2 annex 5) livestock diseases,( ECF, anaplasmosis, trypanosomosis and helminthiosis, LSD and FMD) with however that, they had less knowledge about the symptoms and the causal reasons as they depends mostly on the livestock field officers to identify and treat the disease cases. However, those from extensive production system had comparatively higher knowledge.
Following cross checking their understanding, participants were taken through each mentioned disease/condition briefly for them to at least understand the key symptoms and management measures as well as the advisory services to be considered like the withdraw period for the drugs used.

**Disease impact in production parameters**
Farmers ranked the five (anaplasmosis, trypanosomiasis, helminthiosis, ECF and CBPP) most detrimental cattle diseases in decreasing order of their effect on benefits. Farmers listed and scored the benefits before distribution of the benefits to each disease using disease impact matrix score as shown (figure 5 annex 5). The benefits for the extensive system were chosen because there was little disparity in the scores, while extensive system has all benefits within semi intensive. Animal health is a constraint in cattle production within the village particularly to the extensive farmers who suffer from many diseases.

The semi intensive system suffers mainly from mastitis which may be associated to poor management practiced, reduced milk production from stress and helminthes from poor hygiene apart from close contact and small herd size. However the cost of managing diseases was said to be high in both systems. For the extensive system, due to movement with animals in search of grazing pasture there is high contact with ticks and biting flies which leads to high incidence of diseases compared to intensive system. Anaplasmosis is the most affecting the cattle followed by trypanosomosis, helminthes, ECF and CBPP. Anaplasmosis is always late detected hence leading to high mortalities.

**Animal health services**
Farmers get animal health services like drugs, advisory services and treatment from the local animal health officer and local agro vets within the area. Local animal health officer is easily accessed through phone and comes to each area on weekly basis. News on animal health issues are sometimes through radios.

**The average population and breeds of cattle in the community**
The participants enumerated their stock size and breed as shown (table 3 annex 5). From the participant’s response, the dominant breeds kept in Kabuku are the cross breeds (mainly Friesian) which was confirmed by the transect walk after the interview.

**Public Health**
The participants mentioned most common diseases/symptoms in descending prevalence as follows 1) Malaria 2) typhoid fever 3) vomiting and diarrhoea 4) cholera (outbreak occurs ones yearly during dry season) 5) bloody diarrhoea (amoeba) and 6) tuberculosis. They were unanimously for the opinion that nearly everyone suffers from malaria at least once within a year, followed by typhoid because of poor hygiene and lack of clean drinking water. Diarrhoea and vomiting were associated with drinking unsafe milk and water, bloody diarrhoea associated with amoebic dysentery linked to lack of safe drinking water bloody persistent diarrhoea was said to be common, and tuberculosis was ranked lowly due to its prevalence only in groups who do not follow good milk hygiene practices and lack awareness on how it is spread.

**Milk borne diseases and other zoonotic diseases**
Disease knowledge and practices
The participants were aware of zoonoses and identified the following zoonoses and milk borne diseases rabies, tuberculosis, anthrax, Rift valley fever, avian and swine flu. One farmer said his nephew was diagnosed with anthrax after eating meat and showing carbuncles but was treated and recovered. Tuberculosis was said to be associated with consumption of raw milk, undercooked meat from infected cattle and lack of milk sieving and boiling. Milk sieving and boiling was seemingly believed by the participants to reduce pathogens in milk and contributes to reduction of risk this coincided with one
participant commenting that “generally some people consume raw unpasteurized milk alleging that it is a medicine”. This was followed by advice on the important of pasteurizing milk before consumed. The participants were knowledgeable on hygiene milking practices and the need to observe drug withdrawal period in lactating cows.

Sindeni village, Handeni District, Tanga

Constraints in livestock keeping
The group identified the main important constraints affecting livestock keeping in the village whereby the pair wise ranking (figure 1 annex 6) gives the constraints findings. Lack of water was ranked as the most constraint followed by milk market, pastures/feed, theft and lastly diseases. The group cited general lack of water due to long distance and seasonal dams forcing them to travel with their animals for watering them. Feeding is a problem too and it is associated to grazing into the individuals owned lands hence high chances of interpersonal conflicts. Market for milk is lacking due to dishonest from milk processing plant as the Tanga fresh collection center used to collect milk from Sindeni, was mismanaged leading to majority of milk producers lost money from milk they had delivered on credit. Diseases ranked low among pastoralists since they believe they can be prevented and each farmer is a “veterinarian” for his livestock.

Proportional pilling for cattle exit from the community
Reasons for cattle exit were said to be due to sales, drought, theft and selling to meet family needs. Figure 2 annex 6 summarizes the relative proportions of the livestock that exit from the community with respect to the exit reason(s) followed by (figure 3 annex 6) the pie chart showing the relative percentages of each reason from the cattle exited from the village. The group had consensus that on average proportion of 56% of animals exit the community and the remaining proportion is 44% of the total. The 41% from drought, 37% selling for their daily livelihood, 13% theft which was said to be rampant and 6% dowry which currently is becoming outdated.

Proportional pilling for the herd morbidity, mortality and case fatality
The key informant mentioned the main livestock diseases that affected his herd over the past one year and lastly the team came up with the relative morbidity, mortality as well as case fatalities for the specific diseases as shown (figure 4 and table 1 annex 6). The most prevalent disease is ECF closely followed by CBPP with anthrax being the third in the last one year. Anthrax though with low morbidity, upon outbreak, results into high mortalities (7) compared to ECF (4) CBPP (5) as well as case fatalities 58.3%, 14.3% and 19% respectively. This is attributed to the fact that, there is no routine vaccination against anthrax while the disease occurs as an outbreak associated with sudden death contrary to CBPP and ECF which upon manifestation of clinical signs, farmers can treat the cases either themselves or look for advice from the LFO and hence reduced case mortalities and fatalities.

Diseases identification
The participants were able to identify livestock diseases (table 2 annex 6) and they had significantly good knowledge about the symptoms and the causal reasons as they spent most of their time with live stocks as well as carrying out diagnosis and treatment themselves. Following cross checking their understanding, participants were taken through each mentioned disease/condition briefly for them to at least understand the key symptoms and management measures as well as the advisory services to be considered during treatment. Apart from knowing that ECF is distributed/spread by ticks to their cattle, farmers had another believe of the disease to be associated with certain pastures. Through probing, it was revealed that, ECF cases occurs when livestock are migrated for better pastures during dry season place where animals will not get access to dipping facilities against ticks.
As for the trypanosomosis, participants explained to be due to grazing livestock along the river where there are shrubs and long grasses as well as the biting flies. They further revealed that, once the livestock eats the flies they automatically get infected. This justifies their knowledge on disease causation though corrected that, the infection is due to the bite of the animals by the flies (tsetse flies and others mechanically like Tabanus spp.) and not by the animals eating the flies.

**Disease impact in production parameters**

Farmers ranked the five most detrimental cattle diseases in decreasing order of their effect on benefits. Farmers listed and scored the benefits before distribution of the benefits to each disease using disease impact matrix score as shown (figure 5 annex 6). From the matrix scoring, CBPP was found to be the most livestock disease affecting the household livelihood of the livestock keepers followed by ECF, anaplasmosis, babesiosis in Sindeni village. The CBPP was explained to be endemic in the area, ECF treatment and the vaccine very expensive, anaplasmosis is treatable but difficult to be diagnosed in the early stages, FMD comes inform of an outbreak with high mortalities in calves associated with reduced milk production and lastly was babesiosis with less occurrence frequencies and easily to be treated.

**Animal health services**

The pastoralists have the perception that each livestock keeper is an expert on livestock disease diagnosis and treatment, which is occasioned by the fact that treating animals is an art they learnt from their parents. One man commented that ‘all of us are experts in livestock health of our animals’. Vaccination is carried out by government in which, pastoralists are asked to prepare the cattle holding ground and pay for some charges like transportation for the vaccinators. During the FGD on livestock diseases and symptoms participants were very active, overshadowing the other participants owing to their close personal attention to livestock while other farmers depend on advice from government animal health officer for advice and treatment. There are fewer veterinary services from the government health officers and only a few provide vaccination. This is due to the fact that, the veterinary services in Tanzania has been left to the private sector who have not yet invested in Sindeni village an basically is due to the remoteness. However, farmers get s animal health services and or information from the neighbouring village located about 5 km.

**The average population and breeds of cattle in the community**

The participants enumerated their stock size and breed as shown (table 3 annex 6). The dominant breed in Sindeni is Tanzania Short Horn Zebu. It is worth noting that it is a taboo for Maasai pastoralists to count their livestock and hence the approximation given is not reliable. The good example from FGD was that, one man reported to have vaccinated 140 calves against ECF and they are all safe to date. However, when asked the size of his herd he said he owned only 50 cattle (both adults and calves), likewise one woman said they are not allowed to count the stock. This translates to getting the type of cattle kept and their production system only and not relying on the number owned.

**Public Health**

The participants mentioned human diseases/symptoms which are commonly seen in their community and list them in order of frequency occurrence. Thereafter they gave out the reason of the ranking order as follows. The disease symptoms were mentioned by the FGD participants in order of occurrences.

- a) Fever
- b) Headache
- c) coughing
- d) malaise
- e) malaria
- f) loss of appetite
- g) diarrhoea
- h) amoebic dysentery
- i) typhoid
- j) yellow fever
- k) nausea & vomiting.
Reason/opinion of the ranking order
They were for the opinions that, the first symptom of any disease is fever which develop to headache, when you don’t get treatment headache develop into cough and malaise. If the above symptom persists malaria will develop leading to loss of appetite and diarrhoea. Amoebic dysentery and typhoid fever infection is from drinking unsafe water particularly during dry season causing nausea and vomiting and stomach ache. It is worth noting that it was difficult for the participants to distinguish diseases from symptoms hence the two are mixed in the ranking. Coughing is associated to tuberculosis, while loss of appetite and diarrhoea are associated with both typhoid and malaria.

Milk borne diseases and other zoonotic diseases
Knowledge and practices
It was probed from the participants if they are aware of diseases that can be acquired from animals to human. Participants were aware of zoonosis by mentioning diseases like, tuberculosis, FMD, brucellosis, rabies and anthrax. Participants were further probed on the symptoms in human and revealed the following

The FGD perceptions on symptoms in humans
Foot and mouth disease-leads to sores in the lips and mouth
Tuberculosis-persistent coughing, mortality rate is very high, patients get admitted for 60 days for treatment in referral hospital in Kilimanjaro region called Kibongoto, mostly affecting the children; one man said his child is currently suffering from Tuberculosis.

Anthrax-severe diarrhoea and vomiting and all who participate in eating the meat will be affected. One participant reported that; his 4 in-laws had suffered from anthrax after eating meat from dead carcass. Note: They have good knowledge of tuberculosis and the way it is spread from animals to human and human to human. The proportion of those who boil milk among participants was 4/11. This has implication that, average of 7 out of 11 people consumes raw (unpasteurized) milk which exposes them to zoonotic and milk borne pathogens. It was reported that; most of the consumed milk by the adults is the fermented milk (mtindi). However, one woman explained a typical way of milk consumption by children, in which she said “as you milk early in the morning, children always cry for milk as they are hungry which necessitate giving them fresh raw milk so that she can continue milking other cows”. It wasn’t strange then getting a comment from one male participant that he all along knew tuberculosis is a disease of the children. Fresh milk takes 2 days to ferment during wet season while only 24 hours during dry season. Generally, there are some who neither boil nor sieve milk before consumption while some do sieve and boil before consumption and some do sieve only. Moreover, those who sieve milk presume that it is safe enough.

Consumption of raw milk and raw blood from subclinical healthy cattle (as in Mwade and Twatwata villages) is a predisposing factor particularly due to rich nature of blood that supports growth of many pathogenic microorganisms. Raw and fresh blood from subclinical heath cattle may predispose livestock keepers especially those lacking routine vaccination against diseases like anthrax to zoonosis infection. It was noted that, goats fore stomach is used to plastering/bandage patient suffering from anthrax wound followed by given to women for eating the used bandage. Giving this to Women, may as well predispose them to anthrax infection.

The farmers as well do not observe withdrawal period after treating their livestock which may lead to microbial residues above maximum residue limit and consequent antimicrobial resistant. The dead animals are consumed and with pastoralist habits of half roasting the meat, may increase the risk of food borne illness to human since the cause of illness is always hardly well-known.
**Kwampunda village, Lushoto District, Tanga**

**Constraints in livestock keeping**
The group identified the main important constraints affecting livestock keeping in the village whereby, the pair wise ranking (figure 1 annex 7) gives the constraints findings. The constraints rank in order of decreasing important: breeds, diseases, feeds and water. The prevalence of livestock diseases, low potential cattle breeds, lack of feed and water during drought. Lack of good cattle breeds was the leading constraints according to the participants; this was attributed to lack of high milk producing potential bulls and artificial insemination as most farmers have short horn Zebu which gives partly 3 liters per cow per day, incidences of inbreeding were said to be common as there are very few bulls hence inbreeding cannot be controlled. Livestock diseases ranked second due to livestock mortalities and the high costs of treating livestock particularly the East coast fever which was said to be endemic. Feed and water ranked lowly as shortage is only experienced during dry seasons.

**Proportional pilling for cattle exit from the community**
Reasons for cattle exit were said to be due to sales, dowry, ceremonies and burials and they are all non-livestock disease related reasons. Figure 2 annex 7 summarizes the relative proportions of the livestock that exit in the community with respect to the exit reason(s) followed by (figure 3 annex 7) the pie chart showing the relative percentages of each reason from the cattle exited from the village. The main reason for cattle exit was cited as sales to meet family needs like educating children, medical expenses, to build house and buy land followed by paying dowry, burials and ceremonies (traditional). From the FGD it was noted that; meeting expenses is the main reason for sale. Dowry ranked lowly because it can be paid in installments hence does not take much livestock.

**Proportional pilling for the herd morbidity, mortality and case fatality**
The key informant was interviewed about his livestock herd health as for the past one year. He mentioned only two cases that affected his herd namely ECF and worms and lastly came up with the relative morbidity and mortality. No case fatality derived from his herd as all cases were manageable and recovered thus no mortality was experienced from the two cases as shown (figure 4 annex 7).

**Diseases identification**
The participants were able to identify three livestock diseases in their area positively with their symptoms namely ECF, anaplasmosis, foot rot and worms (table 1 annex 7). However, apart from knowing the diseases and their symptoms, they had no idea on management measures as they only depend on the village livestock auxiliary. Following cross checking their understanding, participants were taken through each mentioned disease/condition briefly for them to at least understand the key symptoms advised to maintain the spirit of using the village livestock auxiliary as well as livestock field officers advice.

**Disease impact in production parameters**
Farmers first listed and scored the benefits before distribution of the benefits to each disease using disease impact matrix score as shown (figure 5 annex 7). From the matrix, anaplasmosis is the most disease affecting the benefits and this is associated by inadequate knowledge for early detection and reporting. The ECF carries close weight to anaplasmosis due to its high treatment cost. However, the two conditions are distributed by ticks of which during FGD it was noted that; there is a dip tank in Kwampunda village but it is not working which could be the main reason for tick borne diseases.
Animal health services
The participants were for the opinion that they get all animal health services from village auxiliary livestock officer and Ward livestock field officer, who attends the sick animals on call and sometimes offer free services. They do not have agro vet in the area to source livestock drugs and thus the animal health officer buys drugs and treats livestock himself. It is worth noting that farmers rely fully on him for everything and incase of intervention in animal health service delivery, more information should be generated from him.

The average population and breeds of cattle in the community
Livestock number and breed is a good indicator of the potential of an area for investment in milk collection center and animal health services provision. The participants enumerated their stock size and breed as shown (table 2 annex 7). Highest stock size owned was 5 cattle, with most participants owning 1-2 cattle. The dominant breed in Kwampunda is the Tanzania short horn zebu.

Public Health
The participants were asked to mention the most common disease symptoms in their area following disease symptoms were mentioned by the FGD participants in order of prevalence: fever, malaria, abdominal pain, malaise, cough, tuberculosis, diarrhea, nausea and vomiting. The participants were for the opinion that the most common symptom is fever which develops to malaria. Malaria will generally manifest symptoms like abdominal pain and malaise. Cough is also very common and sometimes lead to tuberculosis diarrhoea and vomiting were mentioned as also common in the area due to changing climatic condition in the area. Fever the said is due to changing climatic conditions. While abdominal pain and fever were mentioned to be prevalent throughout the year, diarrhoea and vomiting are common during dry season when clean water is scarce. From our observation it was hard for the participants to distinguish diseases from symptoms hence the two are mixed in the ranking.

Milk borne diseases and other zoonotic diseases
Knowledge and practice
The participants had little knowledge of zoonoses though high tuberculosis incidences were mentioned by participants. Three of them were having children and grandmother with tuberculosis presently, which may be attributed to consumption of raw milk and milk products. It was only tuberculosis known zoonotic disease, with only one participant knew about tuberculosis transmission from inhaling breathing droplets of infected cattle when one share house with cattle.

They generally believed that, raw milk is safe after filtering and couldn’t link raw milk consumption to any diseases. The participants had no knowledge of other zoonotic diseases like anthrax, brucellosis, rift valley fever or salmonellosis. However, brucellosis, campylobacter and salmonellosis could be linked to the symptoms like fever, abdominal pain, vomiting, malaise; their absence in the list could be due to inadequate knowledge by the participants

The participants generally don’t boil milk unless it is for tea or porridge. Milk intended for manufacture of mtindi (fermented milk) is sieved then poured into a fermentation container without heat treatment. They allege that milk can only make mtindi when not boiled and that boiling give bad flavour. The fresh milk consumption by the villagers is relatively less as mostly fed by the children on porridge with milk. The main milk product consumed by the rest of the household members is mtindi.

The participants mentioned that, nearly everyone share house with cattle for security reasons. This practice was observed as possible exposure to tuberculosis through pulmonary route, and other gastro-intestinal pathogens like pathogenic Campylobacter jejuni, E.coli and Salmonella from cow dung. The farmers maintain constant contact with the ward livestock officer whenever their animals are sick or dead. It is the
officer who diagnoses and treats the sick stock, and when livestock is dead or is to be slaughtered it is the officer who gives direction.

Kwangwenda village, Lushoto District, Tanga

Constraints in livestock keeping
The group identified the main important constraints affecting livestock keeping in the village whereby, the pair wise ranking (see Figure 1 and Annex 8) gives the constraints findings. The participants listed their constraints as follows; prevalence of livestock diseases, cowshed/hose, lack of feed and lack of market for milk and live animals. Most participants rear exotic cross breeds which are prone to diseases which ranked as the first most significant constraint in form of mortality and treatment cost particularly the East coast fever and anaplasmosis. Cow shed ranked as the second constraint to the farmers as they noted about the capital required for construction though it is essential for their dairy cattle. Livestock feed is a problem mostly during long dry season when conserved feeds are not there or enough and lastly the market for milk was mentioned but at the moment most of the milk produced is sold to neighbours and restaurants at Soni centre in Lushoto (rural-to-rural consumption).

Proportional pilling for cattle exit from the community
Reasons for cattle exit from Kwangwenda village were said to be due to selling, dowry, theft and ceremonies (religious, cultural and weddings) which are all non-livestock disease related reasons. Figure 2 annex 8 summarizes the relative proportions of the livestock that exit in the community with respect to the exit reason(s) followed by (figure 3 annex 8) the pie chart showing the relative percentages of each reason from the cattle exited from the village. The main reason for cattle exit was cited as sales to meet family needs at 66.70% of educating children medical expenses, to build a house and buy land, followed by both dowry &ceremonies each at 13.30% and partly theft at 6.70% of all exit routes. Sales contribute to more than half the total cattle exit from the community owing to high cash demand. Ceremonies include Christmas, Ramadhan, traditional dances, weddings and group meetings.

Proportional pilling for the herd morbidity, mortality and case fatality
The animal diseases occurrences and mortalities were assessed using one key informant/individual interview. He was interviewed about his livestock herd health as for the past one year. He was supposed to mention the main livestock diseases that affected his herd and lastly try to come up with the relative morbidity, mortality as well as case fatalities for the specific diseases. From the FGD, the number of cattle reared by each farmer was small hence to get representative morbidity and mortality more herds were involved. There was no mortality reported by all four farmers interviewed individually (figures 4, 5, 6 and 7 annex 8). This could be due to the production system (intensive) and the availability of veterinary services from the Livestock Field Officer based in Soni ward close to Kwangwenda village.

Diseases identification
The participants were able to identify the following livestock diseases/conditions occurring in their area though they have less knowledge about the management measures. The diseases/conditions mentioned were mainly; ECF, anaplasmosis, black quarter, mastitis, prolapse and hypocalcaemia (table 1 annex 8). Following cross checking their understanding, participants were taken through each mentioned disease/condition briefly for them to at least understand the key symptoms and or first aid management measures before calling the LFO.
Disease impact in production parameters
To understand the negative impact of the disease as they affect the livelihood benefits farmers derive from keeping cattle. Using the listed diseases/conditions (anaplasmosis, ECF, black quarter, mastitis, prolapse and hypocalcaemia), farmers first listed and scored the benefits before distribution of the benefits to each disease using disease impact matrix score as shown (figure 8 annex 8).

From the matrix, cash income from sale of milk and fermented milk (mtindi) scored highly at 31% live cattle and meat at 16% in form of slaughtered animals, manure which they sell and use in their crops at 32% being the leading benefit from cattle while hide and dowry at 13% and 8% respectively. Dowry is losing value as majority of people do not pay cattle immediately alternatively they rather sale cattle pay cash money so that they will remain with some money. Dowry ranked last because they said paying dowry is not a must and it can take long before one pays.

Manure is the most important benefit the farmers get from their livestock this was attribute to the fact that almost all of them grow horticultural crops and need manure for their farms. The current price of manure is TZX 50–100 per bucket.

The most diseases affecting the livelihood benefits from cattle are tick borne disease-anaplasmosis and ECF followed by, black quarter. The participants mentioned that ECF and anaplasmosis are common leading to decline in production and loss of livestock anaplasmosis can be treated if detected early while ECF treatment is always difficult. The effect of ECF on hide was that, when a cow dies of ECF they bury the animal and the hide hence there is total loss the same applied to animals that died from prolapse as they consider it bad omen. Tick borne diseases are challenges as it was noted from the participants lacking enough knowledge of tick’s control. This was justified from participants as farmers only spray their livestock with acaricides when they spot ticks on their cattle.

Animal health services
The participants were getting all animal health services from Ward and district livestock health officer, who attends sick animals on call. They access information on animal health from radios (for those who own radios) and the livestock field officers.

The average population and breeds of cattle in the community
The participants enumerated their stock size and breed as shown in table 2 annex 8). It is worth noting that the highest stock size owned was 5 livestock, with most participants owning 1-2 cattle. The dominant breed in Kwangwenda is the crossbreed dairy cattle.

Public health
The following disease symptoms were mentioned by the FGD participants in order of prevalence: body weakness, fever, malaria, typhoid, cough, abdominal pain, diarrhoea, vomiting and coughs. Body weakness and fever were reported as the most common symptoms in the area which nearly everyone suffer from, these symptoms develop to malaria or typhoid with time and when they go to hospital they get diagnosed with either malaria or typhoid owing to lack of safe drinking water. Diarrhoea was also associated to bad foods, dirty water and typhoid, while vomiting and coughing were linked to fevers and changing climatic conditions.

Since most food borne and zoonotic disease are associated with symptoms like fever, diarrhoea, and vomiting, abdominal pain, diarrhoea and malaise, it is worth investigating the presence and prevalence of Campylobacter spp., Brucella spp., enterotoxigenic E. coli spp., Listeria monocytogenes, Mycobacterium tuberculosis, M. bovis, Salmonella spp. (non-typhoid) and Toxoplasma gondii to establish a strong link between symptoms and the causative agent.
Milk borne diseases and other zoonotic diseases

Knowledge and practices
The knowledge, attitude and practices in relation to zoonoses and milk borne disease were elicited. This is vital in understanding the prevalence of zoonoses and food borne disease of animal origin. The participants were aware of tuberculosis presence and spread via aerosols from infected cattle breathes. Many participants have had tuberculosis patients in their homes and mentioned how difficult it is treating the disease. Currently tuberculosis was mentioned to be prevalent in the village.

The participants reportedly boiled milk less habitually with the perception that sieving milk alone takes away all the germs. Milk for mtindi making is sieved then poured into a fermentation container without heat treatment. They allege that milk can only make mtindi when not boiled and that boiling gives the milk a bad flavour.

The participants had no knowledge of other zoonotic diseases like anthrax, brucellosis, rift valley fever or salmonellosis. However, brucellosis, campylobacter and salmonellosis could be linked to the symptoms like fever, abdominal pain, vomiting, malaise: their absence in the list could be due either farmer’s inadequate knowledge or to lack of their diagnostic kits. From the FGD, observation was that, the zoonoses knowledge gap is so big that there is need for training on food/milk handling hygiene to reduce exposure. Except for one participant, all of them milked their cows in the cow pen, a practice which may expose them to pathogens from cow dung like Campylobacter jejuni, E. coli and Salmonella. The farmers maintain constant contact with district and ward livestock officer whenever their livestock fall sick or dead, this may reduce exposure to antimicrobials hence mitigate against antimicrobial resistant.
Key findings

Following the interviews in the 8 villages, there were some similarities and differences on the collected information between the villages as well as between the production systems. The similarities among others were; the livestock keepers greatly depend on livestock keeping for their household livelihoods and diseases have great impact on the benefits farmers derived from keeping cattle.

The differences among others were; under extensive system, farmers are more knowledgeable about livestock diseases comparably to intensive production system. More so, the knowledge and practices human illness sourced from animals is higher under intensive production compared to extensive production system.

In view of the above, the following were the key findings with respect to the specific study objectives;

The roles diseases play in constraining production

Farmers were found to depend on livestock production for their daily livelihood some solely while some on both livestock and crop production. Diseases plays great roles in constraining livestock production as well affecting the household’s benefits farmers derive from keeping livestock both in extensive and semi intensive/intensive production systems.

Under extensive production system, pastoralists have relatively good knowledge of the diseases in their areas. This could be due to the fact that, the reported diseases seemed to be endemic. Diseases reported by the participants to be frequently in their area were; viral (FMD and LSD), bacterial (black quarter and anthrax) tick borne diseases (ECF, anaplasmosis, heart water and babesiosis), trypanosomiasis and CBPP. Livestock selling to meet household needs were found to range from 22.22% to 46.30% whereas the disease impact to benefits from livestock ranges from 25/% to 57% and mainly from CBPP, ECF and LSD.

Under semi intensive/intensive production systems, farmers had less knowledge on diseases causation but with advantage that, they are more close to the livestock field officers who diagnose the disease for them and institute the required treatment. Diseases/conditions frequently under these systems are mainly; tick borne disease, mastitis and worms. Livestock and livestock products selling to meet the household needs were found to be up to 62% whereas the diseases impact to benefits derived from keeping livestock reached 40% and mainly from tick borne diseases in particular ECF and anaplasmosis.

Farmers’ knowledge on disease causation

Under extensive system, farmers have exiting veterinary knowledge inherited from earlier generations. Since they are completely dependent on livestock for their livelihoods they know a lot about diseases affecting their animals carrying information well-matched with formal veterinary knowledge. However, they have less knowledge to distinguish between diseases and the clinical signs thus making them have list of more diseases during interviews. This brings a possibility that most of the treatments carried out are more of either symptomatic, assumptions or trial and error based and hence probable drugs misuse. Under this system, most of the drugs used apart from the trypanocidal are the broad spectrum antibiotics which covers ranges of bacterial infections and that is why viral, mycoplasma and tick borne diseases remain to be the major problem in their area. Contrary to semi intensive/intensive systems with less knowledge of diseases causation but rely mainly to livestock field officers and hence with less problems apart from the high cost of treating livestock’s and high impact from anaplasmosis due to late recognition of the disease.

Animal health services that are accessed by farmers

Generally, there are no proper animal health services accessed by the extensive production systems compared to semi intensive/intensive system. Under extensive system, livestock keepers source drugs from informal drugs sellers and primary livestock markets located 1-58 km away. Some areas have no livestock field officers, no vaccinations programs and inadequate dipping facilities. Under semi intensive and intensive systems, they are more advantaged as they are close to the livestock field officers, there are formal agro
vets shop, some have vaccinations programmes and they keep few cattle that can be sprayed against ticks and biting flies compared to extensive where they need dip tanks.

**Animal source human health problems**

There were several numbers of animal source human health problems identified among others; human tuberculosis, anthrax and typhoid which could be associated with consumption of livestock products especially milk and meat. Inadequate knowledge about zoonoses from both production systems and mainly the extensive of the possibility of infection from livestock to human was found to be at high.

- Some examples were raw/unpasteurized milk was said to be medicinal
- Consumption of fresh blood was said to be common
- Consumption of ruminal juice is common?
- Majority do not pasteurize milk,
- Fermented milk is not boiled prior to fermentation
- Filtration of milk is believed to make milk safe for consumption
- Children are given raw/unpasteurized milk early in the morning
- Tuberculosis was said to be a disease for children and number of participant confess to have their in-laws suffering from tuberculosis and milk for fermentation need not be pasteurized as it loses flavour and taste
- The milking process to consumption further reveals possibility of acquiring health problems from animals including the handling of milk (storage and transportation)
- Some identified livestock keepers beliefs: Filtering or sieving is enough to get away all bacteria that can affect human, no human can get infected from the same diseases affecting livestock.
- Hard work results in tuberculosis occurrence in human and fresh blood from cattle is highly nutritious.
- Some zoonotic diseases in human were linked to witchcraft.
Conclusions

Farmers were found to be greatly depending on livestock and livestock’s products for their livelihoods in the study area. Majority of cattle kept are the Tanzania short horn zebu and the exotic crossbreeds under extensive and semi intensive and intensive systems respectively. The zebu produces less milk though compared to the crossbreeds which are fewer but with relatively higher production. Their relative numbers in both production systems in a given District/village has influence on milk availability though with a much wider seasonal variations under the extensive system.

Under each system, several constraints mainly; pastures, diseases, breeds, markets and animal health services were elicited which either affect the production or have negative impact on the benefits farmers derive from cattle keeping for their daily households livelihoods.

The identified low access to or no animal health services as well as the public health risks potentials from inadequate knowledge, eating habits and beliefs about zoonoses, put farmers themselves and public at large in high risk of milk borne and other zoonotic diseases. The likelihood of unsafe food consumption especially from cattle products (milk and meat) is high due to less quality animal health services.

Symptoms of illness caused by various bacteria commonly found in raw milk may include vomiting, diarrhoea, abdominal pain; fever, headache and body ache which were identified during the interview and participants revealed that, majority do not pasteurize milk apart from other noted old believes.

While addressing other constraints for more production and livelihood improvement, animal health should be the first priority under the One Health philosophy (healthy animals, healthy people) which will minimize human risks associated with keeping cattle as well as consumption of animal-source food products.
Recommendations

In view of the above, interventions for more safe food especially consumption of animal products from both production systems, education will be the key approach focusing on animal health and management husbandry, zoonotic diseases, meat consumption, milk consumption and handling. These will be possible through; establishment of; decentralised animal health systems, vaccination programmes, farmers groups and further studies to confirm the study findings on public health. Lastly but not the least are the critical points to be looked at which are; hygienic milking procedures, Consumption habits (milk, blood and carcasses), milk storage (for home use and sale) and milk transportation.

**Strengthening animal health services**

In collaboration with the district council and or regional livestock adviser offices, there is a need to strengthen the animal health services in the respective villages. This could be through the following:

*Under extensive systems: (Mbwade, Twatata, Kambala and Sindeni)*

The less or no animal health services in these areas can be solved through activation of the centralised animal health system at village level. This is by training of the Community Based Animal Health Workers (CAHW’s) who will be close to the government livestock officers and the livestock keepers which will enable them to access veterinary drugs and advise specifically on diseases in their area. It is further recommended that, the trained CAHW’s to be recognized by the Tanzania Food and Drugs Authority (TFDA) for them to be more legitimized.

The project in collaboration with the respective authority to select, train and equip the CAHW’s thereafter connect them with formal drug stores (public private partnership) as a reliable source of veterinary drugs as well as a continual learning centre. The authority will be responsible for establishment of recording forms/format for both diagnosis, treatment and drugs sell for the CAHW’s to fill in which will serve as the basis of both diseases surveillances in the area and monitoring the services. Monthly report from the CAHW’s to the district will be vital for back up or refresher training base for the system to be sustainable. During training, key issues like, hygienic milking procedures, Consumption habits (milk, blood and dead carcass), milk Storage (for home use & for selling) and milk transportation to be addressed as following training, CAHW’s will have a take home message for the rest with respect to both public health.

*Under semi intensive and intensive systems: (Manyinga, Kabuku, Kwampunda and Kwangwenda)*

The animal health services are easily accessible and mainly provided by both government officers and the private veterinary suppliers. Great emphasis should be in the quality services, advice on breeding, feeding and good husbandry management systems. This can easily be performed through village meetings and farmers groups meeting in collaboration with the district or ward livestock officers. The key take home message in each meeting will be; hygienic milking procedures, Consumption habits (milk, blood and dead carcass), milk Storage (for home use & for selling) and milk transportation.

**Establishment of compulsory vaccination programs**

Diseases mainly CBPP, LSD, FMD and ECF were found to play great impact in livestock keeper’s household livelihood and hence needs great attention.

*Under extensive systems: (Mbwade, Twatata, Kambala and Sindeni)*

Livestock vaccination services are not accessible and if accessed are expensive especially ECF vaccine. The CBPP vaccine is currently controlled by the government whereas LSD, ECF and FMD are private goods. However, FMD vaccine is not easily available and if available will likely be not of similar strains due to antigenic diversity of FMD strains which complicate and necessitate identification of the currently potential outbreaks strains in the area.
It is therefore recommended that in collaboration with the respective authorities in compulsory fighting against CBPP and LSD as some farmers especially under intensive production system they do not vaccinate even if the service is free. The available cold chain system to be assessed and use of trained CAHWs to mobilize farmers and carry out vaccination at least for two years consecutively. Arrangement for the vaccine availability can be through regional livestock office adviser and the Ministry of Livestock Development and Fisheries TADS department.

To fight against ECF which is a private good, it is recommended to use trained CAHWs as well as key informants to mobilize farmers to vaccinate using the currently recognized vaccinators. However, due to the high cost of the price, it is further recommended the possibility of the partner project to lobby for funds which will be used to subsidize the price (cost sharing with farmers). This will motivate more cattle keepers to vaccinate and afterward adopt the vaccine.

During fighting against the aforesaid diseases, it is further recommended to introduce vaccination against anthrax, black quarter and rabies found to be endemic in these villages. The take home message in each stage of intervention to be, hygienic milking procedures, Consumption habits (milk, blood and dead carcass); milk Storage (for home use and for sale) and milk transportation.

**Under semi intensive and intensive systems: (Manyinga, Kabuku, Kwampunda and Kwangwenda)**
Given the close contact with animal health service delivery personnel's and the main disease under this system is ECF, it is recommended to raise farmers awareness about the vaccine availability, train one ECF vaccinator in each village, equip them and connect them to the supplier. The take home message to be carried by the vaccinator to farmers during vaccination to be, hygienic milking procedures, Consumption habits (milk, blood and dead carcass), milk Storage (for home use and sale) and milk transportation.

**Formation of farmer groups**
It is recommended to either form new or re organise the existing farmer's groups/organisation for collective voice and better learning. This will be training them on group’s dynamics (training manual available upon request) and possibly becoming the micro credit schemes like village community banks.

**Under extensive systems: (Mbwa, Twatata, Kambala and Sindeni)**
Improvement of milk production as well as more meat for more food they can be supported by better bull in each group where by members of the group will contribute heifers to cross breed with the bull. The outcome may be copied by the rest of the farmers (spill over effect) buying their own. For diseases control, especially tick borne diseases (babesiosis, anaplasmosis and heart water) as well as trypanosomiasis, given the herd size owned, it is recommended to rehabilitate the existing dip tanks and commercially run by the farmers groups.

Given organized and formal groups, it is recommended to establish milk collection centre within the area run by the group in particular Sindeni where all potentials for investments are available. This further needs to go hand in hand by educating and or supporting farmer’s milk carrying containers (stainless steel) as the currently used are locally available plastics after being used for other purposes like storage of cooking oil etc. The take home message to be carried by whoever will be facilitating the group formation or strengthening to be hygienic milking procedures, consumption habits (milk, blood and carcass), milk storage (for home use and sale) and milk transportation.

**Under semi intensive and intensive systems: (Manyinga, Kabuku, Kwampunda and Kwangwenda)**
Under this system, farmers are more organised with exception of Kwampunda village and hence recommended to strengthen them. Strengthening is recommended to increase their awareness on important of using artificial insemination service instead of natural breeding method which was found to results into reduced milk production. Within the groups, training them as well good husbandry management system...
and lastly raising willingness to use the stainless steel equipment for storing and transporting milk. The take home message for the facilitator should be: hygienic milking procedures, consumption habits (milk, blood and carcass), milk storage (for home use and sale) and milk transportation.

**Education, further studies and record review**

Following the interviews, it was realized that, there are possible numbers of human illness sourced from animals. However, some of the cattle rearing people have less knowledge about the illness while majority especially under extensive systems lack this knowledge and hence put them to high risk of infection. Most of the residents were therefore found to be potentially at high risk of pathogenic and milk borne zoonotic diseases from contact with cattle, consuming raw milk and raw milk products. The following are therefore recommended in both systems and in particular the extensive system.

**Education**

On milk hygiene and consumption of pasteurized milk as well as the importance of not drinking fresh milk from sick and animals under medication which may increase antimicrobial resistance due to antimicrobial residues for human being.

To raise awareness about zoonotic diseases especially the milk borne diseases since some people don’t believe one can get disease from livestock.

Use of pictures with messages that explain the major routes of the possible diseases infection from cattle to humans.

Education on good livestock management practices to reduce exposure to zoonoses especially avoiding sharing house with cattle to avoid exposure to tuberculosis, *E. coli*, *Campylobacter* spp., *Salmonella* spp. etc.

**Further studies and record review**

To confirm the zoonotic diseases (tuberculosis, brucellosis, typhoid and others) by conducting further studies especially microbiological analyses to identify and confirm milk borne pathogens and thereafter plan for best practices that will minimize the identified sources/causes of infection as a means to improve milk hygiene. This could be during household survey.

Investigate the cause of high incidences of diarrhoea and vomiting that was linked to milk consumption to be either from *E. coli* or *Salmonella*.

Need to review medical and veterinary health and diagnostic records to establish the extent and actual causes of fevers, vomiting and diarrhoea from among those admitted to hospitals. This will equally assist in coming up with the list of major pathogens in the area for risk prioritization.
References


Annexes

ANNEX 1 to 8: Village interviews

ANNEX 9: Participatory epidemiology kit for prioritizing the animal diseases of poor livestock keepers

Introduction
The tool will mainly focus on collecting data through Focused Group Discussion with farmers aimed at having an understanding of the constraints that farmers face in the livestock value chain with respect to animal health. Some efforts will be put in getting a feel of some quantitative aspects arrived at through group consensus. The main purpose of the assessment is to identify opportunities for intervention. Some of the findings need to be triangulated with secondary/key informant/service provider data during the exercise or investigated further at a later stage. The animal health constraints are also to be evaluated in relation to land, labour, capital and information and knowledge.

Objectives
Assess what role diseases play in constraining production (farmer’s perceptions of the importance of health constraints in relation to specific production parameters)
Facilitate own problem analysis on health constraints (diseases, symptoms or syndromes), elicit knowledge on disease causation (host, environment, pathogen)
Assess animal health services that are accessed
Assess animal source human health problems
Cattle keeping constraints
Objective- comparisons get more accurate information on relative importance.
Brainstorm on the constraints to dairying: (consider: feed, disease, markets, improved breeds, low production, insecurity etc.
Develop a matrix with constraints along the top and side: use picture cards
Ask farmers to compare the top and side to say which is most important

Pair-wise Ranking

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Disease</th>
<th>Lack of feed</th>
<th>Lack of markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of feed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of markets</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Check if women have a different comparison matrix. If yes, do it with women only. Check if there’s no other group that could compare the constraint differently (e.g. older/younger people).

Proportional piling for livestock exit and for herd relative morbidity, mortality and case fatality

Tool: Proportional piling (PP) Community livestock exits

Objective: to identify the relative proportion of the livestock population that left/moved from the community for the past one year for several reasons apart from disease mortality. Among others are due to, death from other cause like accidents and poisoning, natural disasters (drought), Gift, lost, loaned e.t.c
The facilitator then divides the village herd into two groups those left/moved out and those remained during the last one year.
Those left/moved out are then divided according to the reasons using 100 counters.
The facilitator and respondents should divide the counters into main five reasons. The rest of the reasons will be grouped under the category of OTHERS (see the example below)

Total cattle in the village

Proportion remained

Proportion exited

Tool: Proportional pilling for Herd Morbidity and Mortality (PPM)
Objective: To identify the mortality and morbidity caused by different diseases as well as assessing productivity
Method:
A circle is drawn on the ground/flip chart (much preferred on the ground) to represent the herd.
A pile of similar sized stones/beans (counters) is put in the circle to represent all the cattle in the individual herd (use 100)
The facilitator request the respondent to divide the herd into two groups: those those were sick during the last year and those that were never sick
The facilitator again to request the respondent to list the main diseases that have affected his herd for the past one year followed by dividing those were sick into specific diseases
Followed by dividing them into groups: those that died from disease and those that died from other causes to obtain crude mortality rates from individual diseases
Those that were sick are divided according to the most common diseases (4 to 5)
The rest of the diseases/conditions will be grouped under the category of OTHERS
For each disease the morbidity and mortality is indicated (see the example below)
The herd relative morbidity, mortality and case fatalities from the figure above.

<table>
<thead>
<tr>
<th>Disease</th>
<th>MB%</th>
<th>MR%</th>
<th>CF%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBPP</td>
<td>10</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>Anthrax</td>
<td>9</td>
<td>3</td>
<td>33.3</td>
</tr>
<tr>
<td>Trypanosomosis</td>
<td>14</td>
<td>4</td>
<td>28.5</td>
</tr>
<tr>
<td>ECF</td>
<td>15</td>
<td>7</td>
<td>46.7</td>
</tr>
<tr>
<td>FMD</td>
<td>8</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>Others</td>
<td>7</td>
<td>4</td>
<td>66.7</td>
</tr>
</tbody>
</table>

Disease Impact in Production Parameters:
Objective: Assessing from the farmer’s perceptions/experience the impact of different diseases on livelihood benefits derived from Livestock.
Tool: Disease Impact Matrix Scoring

Two stages
1st stage: Listing the benefits derived from keeping cattle and score them using 100 counters

<table>
<thead>
<tr>
<th>No.</th>
<th>Benefit</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Milk</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>Beef</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Cash</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Dowry</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Manure</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Skin</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

2nd stage: Diseases identified during the interview are scored by several parameters (Benefits) sequentially to construct the matrix

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Score</th>
<th>Disease 1</th>
<th>Disease 2</th>
<th>Disease 3</th>
<th>Disease 4</th>
<th>Disease 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dowry</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manure</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Animal health services
How often would a typical household use these services?
(Rating: 0 Never, + Yearly, ++ Monthly, +++ weekly),

<table>
<thead>
<tr>
<th>Location</th>
<th>Service provider</th>
<th>Drugs</th>
<th>Treatment</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>In village</td>
<td>Other farmers (neighbours, peers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Community elders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expert farmers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Traditional practitioners</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Informal drug sellers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Untrained community animal health workers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trained community animal health workers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In local towns and/or administrative centres</td>
<td>Agro vets shop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NGOs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extension officers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Informal sector drug sellers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Veterinary officers/Livestock Field Officers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mass media
- Adult literacy
- Radio
- Newspaper
- Television

Public Health
Objective: To assess the extent of present or absence of human commonly clinical signs/symptoms especially those keeping livestock that could be associated with consumption of improper milk handling. These signs may occur as within 30 minutes or more following milk consumption.

Tool: Simple Ranking
Facilitator to ask the participants to rank the categories with respect to the frequency they are experienced in the community

<table>
<thead>
<tr>
<th>Category</th>
<th>Rank</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever/Hot body</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cough</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhoea (3 or more loose stools in 24hrs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anorexia/not eating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscle pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vomiting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weakness</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Milk borne diseases and other zoonotic diseases

Objective: To assess farmer’s general understanding of zoonotic diseases in the area and mainly those could be linked to milk consumption.

Tool: The FGD about milk and milk products consumption (milking, sources, transportation and storage). Probing and observation to elicit details of the social context for the possible occurrence of milk borne diseases

Further constraints analysis
From the list of constraints already identified, and any other, list the four main animal health-related constraints and indicate whether they are related to land, labour, capital or information and knowledge, or to some other basic constraining factors

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Land and water</th>
<th>Labour</th>
<th>Capital</th>
<th>Information/ Knowledge</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AH1.LD.F/S</td>
<td>AH1.LB.F/S</td>
<td>AH1.CP.F/S</td>
<td>AH1.KI.F/S</td>
<td>AH1.OTH.F/S</td>
</tr>
<tr>
<td>2</td>
<td>AH2.LD.F/S</td>
<td>AH2.LB.F/S</td>
<td>AH2.CP.F/S</td>
<td>AH2.KI.F/S</td>
<td>AH2.OTH.F/S</td>
</tr>
<tr>
<td>4</td>
<td>AH1.LD.F/S</td>
<td>AH1.LB.F/S</td>
<td>AH1.CP.F/S</td>
<td>AH1.KI.F/S</td>
<td>AH1.OTH.F/S</td>
</tr>
</tbody>
</table>
ANNEX 10: Participatory epidemiology checklist

- The main constraints/challenges facing livestock (mainly cattle)
- The main livestock diseases in the area
- The five most important diseases affecting their livestock
- Knowledge of diseases causation and main symptoms
- The benefits derived from keeping the livestock
- The impact of the five most important diseases to the benefits derived from the livestock
- Reasons for cattle exit from the community
- Sources of animal health services
- Treatment of the livestock
- Types and frequency of occurrence of human symptoms or illness clinical signs
- Understanding of zoonotic diseases
- Milk handling and consumptions habits
- Advice to farmers