

**Sokoine University of Agriculture**



**MSc. Dissertation**

**Epidemiology and Community  
Knowledge, Attitude and Practice  
towards Lumpy Skin Disease in  
Tanga and Pwani Regions in  
Tanzania**

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**May 2024**

**EPIDEMIOLOGY AND COMMUNITY KNOWLEDGE, ATTITUDE AND  
PRACTICE TOWARDS LUMPY SKIN DISEASE IN TANGA AND  
PWANI REGIONS-TANZANIA**

**A Dissertation Submitted in Partial Fulfilment of the Requirements  
for the Degree of Master of Science in Applied Microbiology of  
Sokoine University of Agriculture, Morogoro, Tanzania.**

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## EXTENDED ABSTRACT

Lumpy skin disease (LSD) is an important viral disease of cattle and water buffalo affecting animals of all breeds and all ages. LSD was first reported in Zambia in 1929, with the first report of outbreak in Tanzania in 1981 and 1986 and considered endemic in many sub-Saharan countries. Presently, the disease is among global threat to the cattle industry due to its rapid spread beyond Africa and having very high morbidity and is therefore, one of the WOAHA listed notifiable transboundary disease. Despite, the high morbidity and associated economic losses, scientific information on LSD in Tanzania remains scarce. The current study aimed to generate information on the seroprevalence and risk factors associated with lumpy skin disease and to assess the community knowledge, attitude and practice (KAP) towards LSD. A cross sectional study was conducted in Tanzania in two regions (Tanga and Pwani) from December 2022 to February 2023. Blood samples were collected from 200 unvaccinated cattle from randomly selected households and their sera were tested for presence of LSD virus antibodies using capripox double antigen multispecies commercial Enzyme Linked Immunosorbent Assay kit (ID.vet Innovative Diagnostics-France). A questionnaire tool was used to collect data through face-to-face interview with herd owners or representatives to assess risk factors for LSD occurrence in the area and to assess KAP. The present study has confirmed presence of LSD antibodies and generated epidemiological information by establishing seroprevalence and risk factors for LSD occurrence. The overall prevalence was 13.5% (CI= 9.06-19.03) and 22.73% (CI =14.47- 32.89) at animal and herd level respectively. Seven (7) factors appeared to have significant influence on the LSD serostatus; namely age (OR= 3.1, CI =0.94-9.94), communal grazing system (OR= 6.14, CI =1.4-26.84), herd size (OR= 0.1, CI =0.02-0.04), introduction of new animal (OR= 3.53, CI=1.53-8.18), source of breeding bull (OR =0.1, CI= 0.03-0.59), rural area location (OR= 2.6, CI =1.0-6.9), breed (OR= 0.3, CI =0.11-0.62) and

free movement and contact with other animals (OR =3.54, CI =1.17-10.704). Animal sex, breeding system and region had no significant association with the observed seropositivity at  $P \leq 0.05$ . Results on KAP revealed that majority of the respondents were aware of LSD and over half of the respondents had past LSD experience. Limited knowledge on LSD clinical signs, associated losses, transmission, control and blood feeding insect role in LSD epidemiology was observed. Majority of the respondents perceived LSD impact and its possibility of occurrence and believed vaccine is important in LSD control, however, majority believed that they had limited access to vaccines. Sharing of grazing areas and watering points, introduction of new animals and sharing of breeding bulls were common practices. Respondent age, herd size, district, role in the households, animal type and past experience on LSD occurrence were significantly associated with the observed KAP. This is the first study to be conducted in Tanzania which has generated important information on LSD including seroprevalence, risk factors and KAP. This information is important in planning and implementation of different control measure. These findings also suggest the need of conducting further studies to identify and characterize the causative agent and to develop vaccine for controlling this economically important disease

**Key word:** LSD, Seroprevalence; risk factors; KAP; Tanzania.

## IKISIRI KUU

Mapele Ngozi (LSD) ni ugonjwa muhimu unaosababishwa na vimelea aina ya virus na huathiri ng'ombe na nyati maji wa aina na rika zote. Ugonjwa huu uligunduliwa kwa mara ya kwanza nchini Zambia mnamo mwaka 1929 na mlipuko wa kwanza kwa Tanzania ulitokea mwaka 1981 kabla ya mlipuko mwingine mwaka 1986. Ugonjwa wa mapele ngozi umeenea na kusambaa katikati nchi nyingi za kusini mwa jangwa la Sahara. Kwa sasa ugonjwa huu ni kati ya magonjwa hatari kwa sekta ya mifugo hasa ng'ombe kutokana na usambaaaji wa haraka hadi kwa mataifa yaliyo nje ya Afrika na kuathiri mifugo mingi kwa muda mfupi. Kutokana na athari zake, ugonjwa wa mapele ngozi ni kati ya magonjwa yaliyowekwa na shirika la afya ya wanyama duniani (WOAH) kwenye orodha yamagonjwa ambayo mamlaka zinatakiwa kuarifiwa pindi mlipuko unapotokea. Pamoja na madhara na hasara kubwa za huu ugonjwa, kwa Tanzania tafiti na taarifa za kisayansi kuhusu ugonjwa wa mapele ngozi ni duni. Utafiti huu ulilenga kuzalisha taarifa za kisayansi kuhusu kueneo kwa ugonjwa, visababishi/vichocheo vya kutokea kwa ugonjwa pamoja na kuanagalia uelewa, mtazamo na mazoea mbalimbali katika ufugaji dhidi ya ugonjwa wa mapele ngozi. Utafiti huu ulifanyika katika mikoa ya Tanga na Pwani kati ya mwezi Disemba 2022 na Feburuari 2023. Jumla ya sampuli 200 (damu) kutoka kwa ngo'ombe wasiochanjwa dhidi ya ugonjwa wa mapele ngozi zilikusanywa kutoka kwenye familia za wafugaji zilizo kidhi na kujumuishwa katika utafiti huu. Sampuli hizi zilipimwa ili kubaini uwepo wa kinga dhidi ya virusi vinavyo sababisha ugonjwa wa mapele ngozi (LSDV) ambapo kipimo cha capripox double antigen multispecies commercial Enzyme-linked Immunofluorescence Assay (ELISA) kutoka ufaransa kilitumika. Dodoso zilitumika pia kukusanya taarifa kwa kufanya mahojiano ya ana kwa ana na mfugaji au mwakilishi wa mfugaji kutoka katika kaya zilizochaguliwa ili kubaini visababishi vya ugonjwa na ueneaji wake pamoja na ufahamu na mtazamo wa jamii kuhusu ugonjwa wa mapele ngozi. Matokeo ya

utafiti huu yamebainisha uwepo wa kinga dhidi ya virusi vya ugonjwa wa mapele ngozi na umezalisha taarifa muhimu kuhusu kiwango cha maambukizi na vichocheo vya kutokea kwa ugonjwa ugonjwa. Kiwango cha maambukizi kilikiwa 13.5% yawanyama wote waliopimwa na 22.73% kati ya kaya zote ambazo Wanyama wake walipimwa zilibainika kuwa na ng'ombe walau mmoja mwenye ugonjwa wa mapele ngozi. Mambo saba (7) yalithibitika kuathiri kiwango cha maambukizi ya virusi vya mapele ngozi ambavyo ni Umri wa mnyama (OR= 3.1, CI =0.94-9.94), kuchangia malisho(OR= 6.14, CI =1.4-26.84), idadi ya mifugo (OR= 0.1, CI =0.02-0.04), uingizaji wanyama kutoka sehemu nyingine (OR= 3.53, CI=1.53-8.18), chanzo cha dume la kuzalishia(OR =0.1, CI= 0.03-0.59), kufuga maeneo ya vijijini (OR= 2.6, CI =1.0-6.9), aina ya ngombe(OR= 0.3, CI =0.11-0.62), pamoja na wanyama kuzurura (OR =3.54, CI =1.17-10.704). hakupakuwa na uhusiano wa moja kwa moja wa mnyama kuwa na kinga za ugonjwa wa mapele ngozi na mnyama kuwa jike au dume. Matokeo yalibainisha pia uwepo wa kundi kubwa la wafugaji wenye ufahamu hafifu kuhusu dalili za ugonjwa, hasara/madhara ya ugonjwa, usambaaji wa ugonjwa, udhibiti pamoja na mchango wa wadudu kwenye kusambaza ugonjwa. Asilimia kubwa ya wafugaji waliamini ugonjwa wa mapelengozi unamadhara makubwa na uwezekano wa kutokea katika maeneo yao ni mkubwa. Washiriki pia waliamini chanjo dhidi ya huu ugonjwa kuwa muhimu japo wengi walibainisha kuwa chanjo hazipatikani kirahisi na pindi zinapopatikana zinazwa kwa gharama kubwa. Mbali na hayo, malisho ya pamoja, kuingiza wanyama kutoka shemu nyingine, kutumia dume moja kuzalisha katika Mazizi tofauti ni mazoea yaliyo onekana kwa wafugaji wengi. Umri wa mfugaji, idadi ya mifugo, wilaya atokayo mshiriki, majukumu ya mshiriki kwenye kaya, aina ya wanyama pamoja na historia ya kupata ugonjwa kwenye mifugo katika vipindi vilivyopita zilionekana kuathiri ufahamu na mtazamo dhidi ya ugonjwa wa mapele ngozi.Huu ni utafiti wa kwanza kufanyika kwa Tanzania ambao umezalisha taarifa muhimu za kisayansi kuhusu ugonjwa wa mapele ngozi ikiwemeo kiwango cha maambukizi, vichocheo vya ugonjwa

pamoja na ufahamu, mtazamo na mazoea mbalimbali ya jamii kuhusu ugojwa wa mapele ngozi. Taarifa hizi ni muhimu kwenye kupanga na kuchukua hatua mbalimbali kudhibiti ugojwa huu. Utafiti huu pia unatoa picha na umuhimu wa kufanya tafiti zaidi ikiwemo utambuzi wa vimelea vinavyo sababisha ugojwa huu pamoja na tafiti za kutengeneza chanjo katika mazingira ya Tanzania kwaajili ya kudhibiti ugojwa huu wenye umuhimu mkubwa kiuchumi.

**Maneno muhimu:** mapele ngozi; kiwango cha maambukizi, vichocheo vya maambukizi; ufahamu na mtazamomo na mazoea ya jamii; Tanzania

## DECLARATION

I **Fredy Makoga**, do hereby declare to the senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

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Fredy Makoga  
**(MSc. Student)**

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Date

The above declaration has been confirmed by;

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Dr. A. Chengula  
**(Supervisor)**

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Date

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Dr. E. Peter  
**(Supervisor)**

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Date

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**DEDICATION**

I dedicate this work to my parents, Mr. Titus V. Makoga and Sabina Mpwapwa and to my sister Anna Makoga.

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**LIST OF ABBREVIATIONS**

bp	Base pair
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
DNA	Deoxyribonucleic acid
ELISA	Enzyme-Linked Immunosorbent Assay
GDP	Gross Domestic Product
KAP	Knowledge, Attitude and Practice
Km	Kilometer
LSD	Lumpy Skin disease
LSDV	Lumpy skin Disease Virus
OR	Odd ratio
PCR	Polymerase Chain Reaction
RPM	Revolution per minute Revolution per minute
TVI	Tanzania Vaccine Institute
TVLA	Tanzania Veterinary Vaboratory Agency
URT	United Republic of Tanzania
USA	United State of America
VNT	Virus Neutralization Test
WOAH	World Organization for Animal Health

## CHAPTER ONE

### 1.0 General Introduction

#### 1.1 Background Information

Lumpy Skin disease (LSD) is an important viral disease of cattle and water buffalo affecting all breeds and all age. LSD is caused by Capripoxvirus a member of family *poxviridae* (Diallo & Viljoen, 2007). Lumpy skin Disease Virus (LSDV) is a large brick-shaped enveloped double stranded DNA virus with about 150kbp genome size (Diallo & Viljoen, 2007).

LSD is characterized by fever, lymphadenopathy, and excessive salivation, nodules on the skin which may become ulcerative and increase the risks of secondary bacterial infection. Drop in milk production, mastitis, abortion and sometimes death are other features of the disease (WOAH, 2021, Koirala *et al.*, 2022). Nodule is multiple, well circumscribed to coalescing 0.5 -5cm in diameter, firm and flat topped. With time a cone shaped central core of necrotic plug (sit fast) always develop within a nodule (WOAH, 2021).



**Figure 1.1:**  
Lumpy skin disease cattle

in  
So

urce: Macsen lab

LSD is linked to significant economic losses from drop in milk production, damage to hide, increased veterinary costs, reduced market

price, abortion and mortalities (Ratyotha *et al.*, 2022). Being a notifiable transboundary diseases, lead to country's restriction to participate in international trade in cattle and cattle products which adds to losses (Mat *et al.*, 2021).

LSD transmission is mainly mechanically by vectors including biting flies (*Stomoxys calcitrans*), tick and mosquitoes (Chihota *et al.*, 2001, Hunter & Wallace, 2001, Issimov *et al.*, 2020, Calistri *et al.*, 2020). International trade in live animals and animal product and movement of animals to weak regulations and porosity of the borders is known to facilitate to transmission of disease between regions and countries (Tuppurainen *et al.*, 2017). However, transmission of LSD can occur direct through contaminated water and pasture but the efficiency of LSD transmission in absence of vector is very (Kayesh *et al.*, 2020). Since its first report in Zambia in 1929 the disease has established in Africa and regarded endemic in many sub-Saharan countries (Baldacchino *et al.*, 2013). The disease causes high morbidity and is WOAHA listed notifiable transboundary disease (Mat *et al.*, 2021, Clemmons & Alfson, 2021, WOAHA, 2021).

LSD prevalence has been estimated in several countries in Africa using serological technique mainly Virus neutralization test (VNT) and Enzyme-linked Immunosorbent Assay (ELISA) with prevalence higher up to 19.5% and 72.3% being reported at animal level respectively (Gari *et al.*, 2010, Abera *et al.*, 2015, Hasib *et al.*, 2021, Ochowo *et al.*, 2019, Selim *et al.*, 2021a). Few countries have assessed the community knowledge towards LSD such as Nigeria and South Africa which indicate large number of people to be aware of the disease (Habiyaremye *et al.*, 2017, Atai *et al.*, 2021). LSD outbreaks has been reported in middle East, Asia and Europe due to expansion of geographical boundaries outside Africa (Tuppurainen *et al.*, 2017). The spread of LSD outside Africa gives the impression for the need of global

coordinated actions to contain and limit the spread and the impact of this transboundary disease for the sustainability of the global cattle industry. Some of the established risk factors for LSD occurrence include age, sex, mean annual rainfall, communal grazing and water sources sharing, introduction of new animals, herd size, animal breed and source of replacement stock (Gari *et al.*, 2012, Ochowo *et al.*, 2019, Selim *et al.*, 2021).

LSD diagnosis is achieved by clinical signs, serological method, viral isolation in eggs or cells/tissue and molecular detection by Polymerase Chain Reaction (PCR) (Milena *et al.*, 2019, Kresic *et al.*, 2020, Saltykov *et al.*, 2021, WOA, 2021, Amin *et al.*, 2021). VNT is widely used as gold standard for LSD diagnosis (WOA, 2021), however, Milena *et al.* (2019) showed high degree of agreement between ELISA and VNT that justify the suitability of both test in detecting anti- LSDV (Kresic *et al.*, 2020). ELISA is a method which detect LSDV antibodies produced following vaccination or natural infection 20 days to 7 months after exposure (Sprygin *et al.*, 2018, Kresic *et al.*, 2020, Calistri *et al.*, 2020). Molecular method is superior to serological method which is time consuming and fail to distinguish LSDV from other capripox members (Soliman & Abdelrahman, 2008). Despite the presence of serological and molecular techniques for LSD diagnosis, the availability and diagnosis cost in sub-Saharan countries is a big challenge, therefore diagnosis mainly depends on clinical signs. OIE, 2021). Farmers are more familiar with skin lesions as LSD signs hence used for diagnosis and reporting the disease (Gambo *et al.*, 2018).

However, it should be noted that other diseases such as pseudo-LSD caused by Allerton virus, insect bite, bovine papular stomatitis caused by parapox virus, dermatophilosis, mite infestation, and besnoitiosis which are also characterized by skin lesion can be confused with LSD (Tuppurainen *et al.*, 2017, Hunter and Wallace, 2001).

Vaccination is an important weapon towards controlling LSD especially in areas where the disease is endemic (Hunter & Wallace, 2001, Issimov *et al.*, 2020, Hunter & Wallace, 2001) but effective control of LSD needs integrated approach including vector control, movement control and extension knowledge to farmers and other stake holders (Beard, 2016, Tuppurainen *et al.*, 2017. Lack of reliable cost-effective vaccine seem to be a global challenge towards LSD control (Beard, 2016). Limited extension knowledge on different drivers of the disease including the importance of blood feeding vectors in transmitting diseases is another factor which might contribute to failure in controlling the disease (Hatami *et al.*, 2022).

Tanzania has over 60 million hectares of rangeland suitable for agriculture and is one of the largest cattle holders in Africa, Yet the productivity of cattle and its contribution to the national GDP is poor with high disease prevalence being one of the reasons (URT, 2010). Since its first outbreak in 1981, unconfirmed LSD cases from different regions is reported regularly (United Republic of Tanzania (URT), 2021), however, the epidemiology and the community knowledge, altitude and practice (KAP) towards LSD is not documented. This creates a knowledge gap on country's understanding of the disease that may affect planning and implementation of different control measure.

## **1.2 Problem Statement and Justification**

LSD is transboundary which is endemic in sub-Saharan countries where Tanzania is among the countries in the region. LSD causes significant economic losses due to drop in milk production, damage of hide, increased veterinary cost, abortion, mortality and due to its transboundary nature, LSD is one of the reasons for country's exclusion to participate in international trade in livestock and livestock products. The disease is therefore not only a threat to the country and global food security but is also responsible for poor performance and contribution of Livestock industry to the national GDP.

Despite, the long history of LSD in Africa and Tanzania and its economic implications, LSD seems to be among the neglected livestock diseases since its epidemiology and community knowledge, attitude and practice (KAP) towards this disease is poorly document. Lack of these information creates a knowledge gap which affect planning and implementation of different control measures and limit the country's ability to assess the efficiency of the in-place control measures.

The proposed study therefore seeks to generate information on the seroprevalence, risk factors and assess the community knowledge attitude and practices towards LSD in Tanzania. This information will be crucial for justification of different control measures to contribute to improved performance of livestock sub-sector in Tanzania and towards improved livelihood.

### **1.3 Objectives**

#### **1.3.1 General objective**

To establish the epidemiology and community knowledge, attitude and practice (KAP) towards LSD in Tanga and Pwani regions in Tanzania.

#### **1.3.2 Specific objectives**

- i. To determine seroprevalence of LSD in Tanga and Pwani regions.
- ii. To assess risk factors associated with seropositivity of LSD in Pwani and Tanga regions.
- iii. To assess the community knowledge, attitude and practices (KAP) towards LSD in Tanga and Pwani regions.

**CHAPTER TWO****MANUSCRIPT I****Seroprevalence and Risk Factors Associated with Lumpy Skin Disease in Tanga and Pwani Regions in Tanzania**

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**Abstract**

Lumpy skin disease (LSD) is an important viral disease of cattle and water buffalo affecting all breeds and all ages. Presently, the disease is among global threats to cattle industry due to its rapid spread and very high morbidity. A cross sectional study was conducted from December 2022 to February 2023 to determine seroprevalence and risk factors associated with LSD occurrence in Tanga and Pwani region. Sera from 200 unvaccinated cattle were tested for presence of LSD virus antibodies using capripox double antigen multispecies commercial ELISA kit (ID.vet Innovative Diagnostics-France). Questionnaires were administered through face-to-face interviews to the herd owners or representatives for assessment of risk factors for LSD occurrence. Anti-LSD antibodies were confirmed with an overall seroprevalence of 13.5% (CI 9.06-19.03) and 22.73% (CI =14.47- 32.89) at animal and herd level respectively. Age (OR= 3.1, CI= 0.94-9.94), communal grazing system (OR= 6.14, CI =1.4-26.84), herd size (OR =0.1, CI =0.02-0.04), Introduction of new animal (OR= 3.53, CI=1.53-8.18), source of

breeding bull (OR= 0.1, CI= 0.03-0.59), rural location (OR= 2.6, CI= 1.0-6.9), breed (OR= 0.3, CI =0.11-0.62) are significantly associated with the observed seropositivity.

**Key word:** Lumpy skin diseases; seroprevalence; risk factors; Tanzania

## 2.1 Introduction

Lumpy skin disease (LSD) is an important viral disease of cattle and water buffalo affecting all breeds and ages. LSD is considered endemic in many sub-Saharan countries, it was first reported in Zambia in 1929 and the first report outbreak in Tanzania recorded in 1981 (Baldacchino *et al.*, 2013). The disease cause high morbidity and is OIE listed notifiable transboundary disease (Clemmons & Alfson, 2021, OIE2021). LSD associated losses include drop in milk production, damage to hide, increased veterinary costs, reduced market price, abortion and mortalities (Ratyotha *et al.*, 2022). LSD transmission is mainly mechanically by blood feeding vectors including biting flies (*Stomoxys calcitrans*), ticks and mosquitoes (Chihota *et al.*, 2001, Hunter & Wallace, 2001, Issimov *et al.*, 2020, Calistri *et al.*, 2020).

The diseases has been spreading across boundaries and rapidly currently outbreaks have been reported in Middle East, Asia and Europe hence LSD is a threat to the global cattle industry (Tuppurainen *et al.*, 2017). The epidemiology of LSD in Africa has been documented in several countries where animal level prevalence of 8.1%, 6.4%, 7.6% in Ethiopia (Gari *et al.*, 2010, Abera *et al.*, 2015, Hasib *et al.*, 2021), 8.7% in Uganda (Ochowo *et al.*, 2019), 19.5% in Egypt (Selim *et al.*, 2021a) and herd level prevalence of 72.3% in uganda (Ochowo *et al.*, 2019), 27% and 20.8% in Ethiopia (Gari *et al.*, 2012, Dubie *et al.*, 2022). Several factors are associated with LSD occurrence such as, age, sex, Season, communal grazing and water sources, introduction of new animals, herd size, animal breed, source of replacement stock (Gari *et al.*, 2012; Ochowo *et al.*, 2019; Selim *et al.*, 2021a).

LSD diagnosis is achieved by clinical signs, serological method, viral isolation in eggs or cells/tissue and molecular detection by Polymerase Chain Reaction (PCR) (Milena *et al.*, 2019, Krešić *et al.*, 2020, Saltykov *et al.*, 2021, OIE, 2021, Amin *et al.*, 2021). Virus Neutralization test (VNT) is widely used as gold standard for LSD diagnosis (OIE, 2021),

however, Milena *et al.* (2019) showed high degree of agreement, between Enzyme-Linked Immunosorbent Assay (ELISA) and VNT that justify the suitability of both test in detecting anti- LSDV (Krešić *et al.*, 2020). ELISA is a method which detect LSDV antibodies produced following vaccination or natural infection 20 days to 7 months after exposure. (Sprygin *et al.*, 2018, Krešić *et al.*, 2020, Calistri *et al.*, 2020). Molecular method is superior to serological method which is time consuming and fail to distinguish LSDV from other capripox members (Soliman & Abdelrahman, 2008).

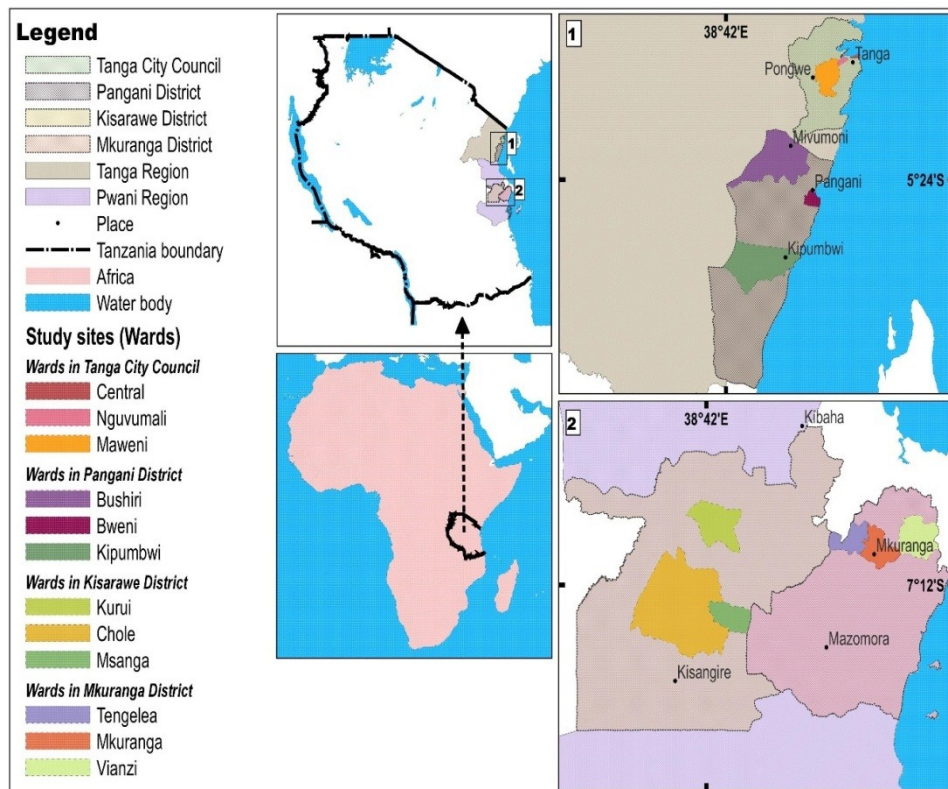
LSD is among the important diseases contributing to low productivity of cattle industry in Tanzania, however there is scant information on the LSD epidemiology which is affecting planning and implementation of effective control strategy. This study therefore seeks to generate epidemiological information on LSD in Tanzania by estimating the prevalence and risk factors for its occurrence in Tanga and Pwani regions. This will help in bridging the existing knowledge gap on LSD in Tanzania and potentially contribute to better control measures for the disease.

## **2.2 Material and Methods**

### **2.2.1 Study Area**

The study was conducted in Tanga and Pwani regions which are among the administrative regions in Tanzania. Tanga is located on 5.3050°S, 38.3166°E northeast of Tanzania bordering Kenya and Kilimanjaro in the north, Manyara region to the west, Morogoro and Pwani region to the south and Indian ocean to the east. Tanga has a total area of 26 667km<sup>2</sup> divided into 11 administrative districts. The study was conducted in two districts of this region namely, Tanga city council and Panga district and three wards from each district which are Kipumbwi, Bushiri and Bweni while Maweni, Nguvumali and Central are the wards from Tanga city council. The average temperature and annual precipitation in Tanga are 26°C and 982mm respectively. Pwani region is located on 7.3238°S, 38.8205°E, with 26.2°C average temperature and average annual precipitation of 995mm. Pwani has a total area of

32 547km<sup>2</sup> divided into eight (8) administrative districts and borders Tanga region to the north, Morogoro to the west and Lindi region to south and surrounds Dar es salaam to east. The study was conducted in Mkuranga and Kisarawe districts, three wards from Mkuranga that were included in the study are Vianzi, Mkuranga and Tengelea while Kurui, Chole and Msanga are wards that were selected from Kisarawe districts.



**Figure 2.1:** A sketch showing a study area in Tanga and Pwani Regions

### 2.2.2 Study design

This cross-sectional study was conducted in Tanga and Pwani regions from December 2022 to February 2023. Multistage sampling method was employed where two district from each region and three wards from each district were selected purposively basing on the availability of different farming system, geographical representativeness, accessibility, willingness of livestock farmers to participate in the study and vaccination history against LSD following consultation with districts livestock extension officers. Ward livestock extension officers prepared list of households and organized logistics for sampling. Household were selected by systematic random sampling from the prepared list. The study involved all breeds of cattle from all farming system in the study area. Only households with at least three (3) cattle were included and a range of 1- 5 unvaccinated animals aged  $\geq 6$  months were randomly selected. Three categories of animals were formed basing on their age from 6 -11 months, 12 - 48 months and above 48months as calves, young and adult respectively. Categories of herds were also formed based on the number of animals as small (1-5) animals, medium (6-20 animals) and large (above 20 animals).

### 2.2.3 Sample size estimation

Sample size was estimated according to Thrusfield (2007) at 95% confidence level and 5% absolute precision. The prevalence rate of 10% used for sample size estimation basing on information of seroprevalence of 8.7% that have been established in Uganda (Ochwo *et al.*, 2019).

The formula for sample size estimation is

$$n = \frac{1.96^2 p(p-1)}{d^2}$$

n is a required sample size

PE is expected prevalence

d is the desired precision

The estimated sample size for this study is 139 animals, to increase the precision a total of 200 animals from 88 herds were included in this study for establishment of the seroprevalence.

## **2.3 Sample Collection, Determination of Seroprevalence and Assessment of Risk Factors**

### **2.3.1 Sample collection and processing**

Blood sampling and processing were performed as per WOAHA protocol (WOAHA, 2021). 1-5 unvaccinated animals selected randomly from each of the selected households/ herds. Whole blood collected by venipuncture from the jugular vein into 10ml vacutainer tube with no anticoagulant. The collected blood was maintained at room temperature in upright position to allow clotting and separation of sera. Aspiration of the sera were done using pipette within 12 hours of collection and transferred into 1.8ml sterile cryovials tube before transporting to TVLA laboratory in cool box with ice packs for storage and analysis. In the laboratory the obtained sera were centrifuged at 3000rpm for 5 minutes and the supernatant transferred into another sterile cryovial tubes and immediately stored at -20°C until testing.

### **2.3.2 Determination of Seroprevalence**

Involved antibodies detection (IgG) from the collected sera and Capripox Double Antigen Multi-species commercial ELISA kit ((ID.vet Innovative Diagnostics-France) (Milena *et al.*, 2019, Ochowo *et al.*, 2019) was employed. All procedures for testing were performed as per manufacturer's instruction. Briefly, optical density measured at 450nm using ELISA microplate and sample percentage (SP) calculated using the formula

$$SP = \frac{(OD_{sample} - OD_{nc})}{OD_{pc} - OD_{nc}} \times 100$$

All sample with SP greater than 30% regarded positive.

Where,  $OD_{sample}$  is optical density of the sample,  $OD_{nc}$  is optical density of the negative control and  $OD_{pc}$  is optical density for positive control.

$$\text{Animal level prevalence} = \frac{\text{Animal tested positive}}{\text{Total animals tested}} \times 100$$

$$\text{Herd Level prevalence} = \frac{\text{Herd tested positive}}{\text{Total herdstested}} \times 100$$

### 2.3.3 Assessment of risk factors

Risk factors were assessed using a designed questionnaire tool which was pre-tested in five households at Drahani ward in Kibaha district. Questionnaire was administered by face-to-face interview to one household member (owner/representative).

Grazing system, breeding system, sources of breeding bull, and history of introducing new animals in the herd, breed, age, herd size, individual animal sex and location of household/ herd are the risk factors that were assessed.

### 2.3.4 Data analysis

Analyses were made by help of epinfo statistical package version 7.2.5 (Centers for Disease Control and Prevention in Atlanta, Georgia). Descriptive statistics was used for analysis of proportions, chi- square test employed to compare and assess statistical significance of variation in prevalence between categories of the selected potential risk factors and logistic regression model performed to calculate odds for evaluation of association between risk factors and the serostatus. All analyses were performed at 95% confidence and 5% p- value.

## 2.4 Results

### 2.4.1 Characteristics of the study population

The study involved 200 animals from the two regions where 114(57%) were from Tanga region and 86(43%) from Pwani region. The number of animals from each district were 72 (36%), 42 (21%), 40 (20%) and 46 (23%) from Pangani, Tanga city council, Mkuranga and Kisarawe, respectively. Other population characteristics are indicated in Table 2.1.

**Table 2.1:** Characteristic of the study population

<b>Parameter</b>	<b>Category</b>	<b>Total</b>	<b>Proportion %</b>
Animal per region	Tanga	114	57
	Pwani	86	43
Animals per district	Pangani	72	36
	Tanga city	42	21
	Mkuranga	40	20
	Kisarawe	46	23
Number of herds per district	Pangani	29	33
	Tanga city	28	31.8
	Mkuranga	15	17.0
	Kisarawe	16	18.2
Sex	Female	166	83
	Male	34	17
Age	6-11 month	58	29
	>1-4years	62	31
	>4years	80	40
Herd size	Small	25	12.5
	Medium	74	37.5
	Large	101	50.5
Breed	Indigenous	107	53.5
	Cross-breed	93	46.5
Grazing system	Zero grazing	59	29.5
	Communal grazing	141	70.5
Breeding system	Natural	170	85
	Artificial	23	11.5
	Both	7	3.5
Location	Urban	42	21
	Peri-urban	57	28.5
	Rural	101	50.5

## 2.5 Prevalence

### 2.5.1 Animal level seroprevalence

A total of 200 sera tested for presence of antibodies against LSDV. 27 Sera tested positive for anti-LSD leading to 13.5% (CI= 9.06-19.03) prevalence. The highest prevalence was recorded in pangani district (18.06%, CI= 9.98-28.6) followed by Kisarawe (17.39%, CI= 7.82-42.42) and Mkuranga ranked third (15.8%, CI= 5.7%-29.84). No seropositive animal was observed from Tanga city council.

### 2.5.2 Herd level seroprevalence

20 herds had at least one cattle positive for LSD antibodies leading to overall prevalence of 22.73% (CI =14.47- 32.89). Kisarawe had the highest prevalence at this level (37.7%, CI =15.2-64.57). Pangani had a second highest prevalence 34.48% (CI= 17.94-54.33) followed by Mkuranga 26.67% (CI= 7.79- 55.1). None of herd had positive animal (s) in Tanga city council.

**Table 2.2:** Animal and herd level seroprevalence

Parameter	Category	Total	Positive	Negative	Prevalence (%)	95% CI
Animal level prevalence	Overall	200	27	173	13.5	9.06-19.03
Herd level prevalence	Overall	88	20	68	22.73	14.47-32.89
Animal level prevalence per districts	Pangani	72	13	59	18.06	9.98-28.6
	Tanga city	42	0	42	0.0	91.59-100
	Mkuranga	40	6	34	15.8	5.71-29.84
Herd level prevalence per district	Kisarawe	46	8	38	17.39	7.82-42.42
Herd level prevalence per district	Pangani	29	10	19	34.48	17.94-54.33
	Tanga city	28	0	28	0.0	87.66-100
	Mkuranga	15	4	11	26.67	7.79-55.10
	Kisarawe	16	6	10	37.5	15.20-64.57

### 2.5.3 Variation in seroprevalence between categories of the selected potential risk factors

Table 2.3 summarizes the result on variation in prevalence between categories of selected variables/ risk factors. Prevalence varied significantly with age categories with highest prevalence in adult cattle. Significant variation also observed with herd size, grazing system and location. Furthermore, introduction of new animals, breed and source of breeding bull are the risk factors that appeared to influence the prevalence. No variation in prevalence between animal sex, breeding system and between regions.

**Table 2.3:** Statistical Inference of Variation in seroprevalence between Categories of the Selected Risk Factors

Factor	Category	Total	Prevalence (%)	CI	$\chi^2$	P value
Age	6-11month	58	6.90	1.96-16.73	4.04	0.0444*
	1-4 years	62	12.90	5.74-23.85		
	>4 years	65	18.75	10.0-29.03		
Region	Tanga	114	11.40	6.21-18.71	0.999	0.320
	Pwani	86	16.28	9.20-25.80		
Herd	Small	25	8.00	0.98-26.03	12.65	0.00004*
	Medium	74	2.70	0.33-9.42		
	Large	101	22.7	15.02-32.18		
Sex	Female	166	15.06	9.99-21.45	2.02	0.154
	Male	34	5.88	0.72-19.68		
Grazing	Communal	116	17.75	11.82-25.05	7.3	0.0069*
	Zero grazing	59	3.39	0.41-11.71		
Breeding	Natural	170	14.12	9.26-20.27	0.42	0.521
	Both	7	0	59.04-100		
	Artificial	20	13.04	2.78-33.59		
Breeding bull source	Shared	109	19.27	12.34-27.93	6.54	0.001*
	Own	65	3.08	0.37-10.68		
Location	Peri-urban	57	7.02	1.95-17.00	9.4	0.0021*
	Rural	101	22.77	15.02-32.18		
	Urban	42	0	91.59-100		
Animal introduction	No	151	9.27	5.16-15.07	9.5	0.002*
	Yes	49	26.53	14.95-41.07		
Breed	Cross	93	6.54	2.67-13.02	9.5	0.002*
	Indigenous	107	21.51	13.66-31.24		

Ref =Reference, \*=significant at  $p \leq 0.05$

#### 2.5.4 Assessment of association between risk factors and serostatus

Table 2.4 summarizes result on association between risk factors and serostatus where age >4 years (OR =3.1, CI= 0.94-9.94,  $p=0.050$ ), Cross breed (OR =0.3, CI= 0.11-0.62  $p=0.0034$ ) and rural location (OR= 2.6, CI= 1.0-6.9,  $p=0.0471$ ) had a significant association with seropositivity. Source of breeding bull also influenced LSDV positivity with reduce odds in herds where own bull was used (OR= 0.1, CI= 0.03-0.59,  $p=0.0078$ ). Furthermore, higher risk also observed in communally grazed cattle (OR =6.14, CI =1.4-26.84,  $p=0.00158$ ), herds with history of introducing new animals (OR= 3.53, CI=1.53-8.18,  $p=0.0032$ ) and in animals from large herd size with increased odds compared to medium herd size (OR= 0.1, CI= 0.02-0.41,  $p=0.0018$ ).

**Table 2.4:** Univariate logistic regression result on assessment of association between risk and serostatus

Factor	Category	OR	95%CI	P-value
Age	6-11 month	Ref	-	-
	1-4 years	2.0	0.57-7.04	0.2803
	>4 years	3.1	0.94-9.94	0.050*
Sex	Male	0.3	0.1-1.4	1.203
	Female	Ref	-	-
Breed	Cross breed	0.3	0.11-0.62	0.0034*
	Indigenous	Ref	-	-
Location	Rural	2.6	1.0-6.9	0.0471*
	Urban	0.00	0.00->1.0E12	0.963
	Peri-urban	Ref	-	-
Region	Tanga	0.7	0.3-1.6	0.402
	Pwani	Ref	-	-
Grazing system	Communal	6.14	1.4-26.84	0.00158*
	Zero grazing	Ref	-	-
Herd size	Medium	0.1	0.02-0.41	0.0018*
	Small	0.3	0.06-1.35	0.1148
	Large	Ref	-	-
Breeding system	Artificial	Ref	-	-
	Both	1.1	0.10-12.75	0.9326
	Natural	1.2	0.33-4.34	0.777
Source of breeding bull	Own	0.1	0.03-0.59	0.0078*
	Shared	Ref	-	-
New animal introduction	Yes	3.53	1.53-8.18	0.0032*
	No	Ref	-	-

Ref =Reference, \*=significant at  $p \leq 0.05$

## 2.6 Discussion

The current study has confirmed the exposure of animals to LSDV and establishes the epidemiology of LSD in Tanga and Pwani regions by determining seroprevalence and risk factors for LSD occurrence. The observed overall animal level seroprevalence is higher than 8.1%, 6.4%, 8.7%, and 7.6% reported previous by Gari *et al.* (2010), Abera *et al.* (2015), Ochowo *et al.* (2019) and Hasib *et al.* (2021) respectively, but lower than 19.5% reported (Selim *et al.*, 2021). On the other hand, the current herd level prevalence is lower than 72.3% reported in Uganda (Ochowo *et al.*, 2019) and close to 20.8% reported in Ethiopia (Dubie *et al.*, 2022). The effect of variability in geographical location, climatic conditions and the season on different drivers of LSD including vector population is probably the reason for the observed variation. Study design and testing method may also be behind the observed difference.

Anti-LSDV were not detected in Tanga city council suggesting limited exposure of animals to LSDV in the city settings which is attributed to low population of biting vectors due to increased human activities which interfere the breeding and resting sites for vectors. Management system where by-laws that restrict animal movement in city setting could also contribute to low exposure.

In the current study, there were variations in seroprevalence between districts which agrees with previous studies reported by Gari *et al.* (2012) suggesting that animals in different districts are exposed at different rates possibly due to variation in prevalence, and distribution of vectors between districts.

On assessment of association between risk factors and the seropositivity, adult animals appeared to be at increased risk to LSDV infection. This finding is in agreement with early reports in Uganda and Ethiopia (Ochowo *et al.*, 2019, Amin *et al.*, 2021). High risk in old animals is linked to increased exposure to LSDV in this age category. In most cases calves are kept separately and protected from disease factors including vectors and hence limited exposure. Presence of maternal antibodies in young animals are also associated with the observed lower risk in calves compared to adult animals.

Unlike the previous findings by Kiplagat *et al.* (2020) and Hasib *et al.* (2021) who reported high risk of LSD infection in cross breeds, in the present study higher odds to LSDV positivity were observed in indigenous breeds. Control of exposure to diseases in indigenous breeds is possibly not stringent as in cross breeds as they are believed to be resistant to most disease than cross breeds, therefore increased exposure can explain the observed findings.

Interestingly, animals from rural areas had over two times higher odds to LSD infection compared to those in peri-urban areas. Probably, environmental factors including presence of large unoccupied land that favour breeding and prevalence of vectors important in LSD epidemiology. Similarly, higher odds to LSD infection observed in animals from the communal grazing system. This is in line with previous finding (Gari *et al.*, 2010, Selim *et al.*, 2021). Increased possibility of mixing and contact between animals from other herds with different health status in communal grazing areas is the possible reason for higher odds in animals in communal grazing system.

The likelihood to LSDV infection also appeared to be higher in large herds which is consistent with previous studies in Ethiopia (Dubie *et al.* (2022). This can be associated with insufficiency pasture leading to

starvation and long-distance tracking of cattle especially during dry season when pastures are scarce causing stress and increase susceptibility to diseases such as LSD.

Furthermore, animals from herds where introduction of new animals and sharing of breeding bulls appeared to increase odds of LSD occurrence which is parallel with previous studies (Amenu, 2018, Issimov *et al.*, 2020). Introduction of new animals especially with lack of rapid and cost-effective diagnostic facilities for health screening increase the chance of introducing animals with sub-clinical disease that will serve as a source of virus and infection in the herd.

## **2.7 Conclusion and Recommendation**

According to our knowledge this is the first report on seroprevalence and associated risk factors for LSD in Tanzania. The study has established a seroprevalence of 13.5% and 22.73% at animal and herd level, respectively. Age, location, source of breeding bulls, introduction of new animals, breed type, large herd size and communal grazing system are the risk factors for LSD occurrence.

Due to importance of this transboundary disease globally, the results of this study indicate the need of providing farmers with the basic extension knowledge on the disease including risk factors and conducting further studies to estimate its burden country wide, isolate and characterize LSDV circulating in Tanzania for LSD vaccine development and better planning and implementation of different control measures.

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**2.9 Author contribution.** Fredy Titus Makoga designed and conducted this study, Dr. Augustino Chengula and Dr. Emma Peter participated in design and played supervisory role throughout this research. Charles Mayenga and Yassin Nassoro participated in logistic for sample collection and analysis. All authors have read and agreed to submit this version of the manuscript for publication.

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**2.11 Data availability-**Data generated can be accessed by emailing [fredymakoga212@gmail.com](mailto:fredymakoga212@gmail.com)

**2.12 Declarations Conflict of interest-**The authors declare the absence of competing interest

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## CHAPTER THREE

## PAPER II

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**Assessment of Community Knowledge, Attitude and Practice (KAP) Towards Lumpy Skin Disease (LSD) in Tanga and Pwani Region-Tanzania**<sup>1,2\*</sup>MAKOGA F., <sup>1</sup>GEDA G., <sup>1</sup>MARK M., <sup>1</sup>JOSEPH P., <sup>2</sup>PETER E., <sup>2</sup>CHENGULA A<sup>1</sup>Tanzania Vaccine Institute (TVI), Tanzania Veterinary Laboratory Agency (TVLA), Dar es salaam Tanzania<sup>2</sup>Department of Microbiology, Parasitology and practice (KAP) towards LSD in Tanzania is poorly understood. This cross-sectional study was conducted in Tanga and Pwani region between December 2022 and February 2023 to assess KAP towards LSD. A questionnaire tool was used to collect information from 116 herds/households. Questionnaire was administered by face-to-face. Data analysis was done using descriptive statistic and univariate logistic regression model. In this study, it was found that majority of the respondents were aware of LSD occurrence (86.93%, CI=79.40-92.51) and over half of the respondents 54.78% (CI=45.23-64.04) had past LSD experience in their herds. However, our study revealed limited knowledge on LSD sign, associated losses, transmission control and on the role of vectors in LSD epidemiology. Majority of the respondent believed LSD has impact (86.09%, CI=78.39-91.83) and believe cattle are at risk (78.26%, CI=69.60-85.41). Moreover, respondents believed vaccine is important in LSD control (70.26%, CI=69.60-85.41). Nevertheless, majority believed they had limited access to vaccine. Respondent age, herd size, district, role in the households, main source of income, time in livestock farming, cattle type and past experience on LSD occurrence appeared to influence both the knowledge and attitude towards LSD in Tanga and Pwani regions.\*Corresponding Author: [fredymakoga212@gmail.com](mailto:fredymakoga212@gmail.com)**Abstract**

Lumpy skin disease (LSD) is WOAHA listed transboundary disease of cattle with high economic impact which threaten the global cattle industry. The disease was first diagnosed in Zambia in 1929 and the first outbreak in Tanzania was in 1981. LSD is regarded endemic in sub-Saharan countries. However, the community knowledge, attitude and practice (KAP) towards LSD in Tanzania is poorly understood. This cross-sectional study was conducted in Tanga and Pwani region between December 2022 and February 2023 to assess KAP towards LSD. A questionnaire tool was used to collect information from 116 herds/households. Questionnaire was administered by face-to-face. Data analysis was done using descriptive statistic and univariate logistic regression model. In this study, it was found that majority of the respondents were aware of LSD occurrence (86.93%, CI=79.40-92.51) and over half of the respondents 54.78% (CI=45.23-64.04) had past LSD experience in their herds. However, our study revealed limited knowledge on LSD sign, associated losses, transmission control and on the role of vectors in LSD epidemiology. Majority of the respondent believed LSD has impact (86.09%, CI=78.39-91.83) and believe cattle are at risk (78.26%, CI=69.60-85.41). Moreover, respondents believed vaccine is important in LSD control (70.26%, CI=69.60-85.41). Nevertheless, majority believed they had limited access to vaccine. Respondent age, herd size, district, role in the households, main source of income, time in livestock farming, cattle type and past experience on LSD occurrence appeared to influence both the knowledge and attitude towards LSD in Tanga and Pwani regions.

**Keywords:** *Farmers knowledge; KAP; LSD occurrence; LSD losses; LSD control; Tanzania*Received: 27/09/23  
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Published: 14/12/23**Cite as:** *Makoga et al., (2023). Assessment of Community Knowledge, Attitude and Practice (KAP) Towards Lumpy Skin Disease (LSD) in Tanga and Pwani Region-Tanzania. East African Journal of Science, Technology and Innovation 5(1).***Introduction**

Lumpy skin disease (LSD) is WOAHA listed transboundary disease of cattle with high economic impact threatening rural livelihood and cattle industry globally (Clemmons and Alfson, 2021). The disease has a long history in

Africa as it was first diagnosed in Zambia in 1929 with the first outbreak in Tanzania in 1981 before it was declared endemic in sub-Saharan countries (Baldacchino *et al.*, 2013). The disease has been reported in all African countries except in Algeria, Morocco, Tunisia and Libya (Tuppurainen *et al.*, 2017). Currently the disease

is spread beyond sub-Saharan countries to Asia, Middle east and Europe, thus is an important transboundary disease with a glob threat (Tuppurainen *et al.*, 2017). LSD epidemiology has been documented in several African countries. Example, animal level prevalence of 8.1%, 6.4%, 7.6% in Ethiopia (Gari *et al.*, 2010, Abera *et al.*, 2015, Hasib *et al.*, 2021), 8.7% in Uganda (Ochowo *et al.*, 2019), 19.5% in Egypt (Selim *et al.*, 2021a) and herd level prevalence of 72.3% in uganda (Ochowo *et al.*, 2019), 27% and 20.8% in Ethiopia (Gari *et al.*, 2012, Dubie *et al.*, 2022) indicating the disease to be real in Africa. LSD is characterized by fever, lymphadenopathy, excessive salivation and nodules on the skin (OIE, 2021). Farmers are more familiar with skin lesions as pathognomonic LSD signs hence used for diagnosis and reporting the disease (Gambo *et al.*, 2018). However, it should be noted that other diseases such as pseudo-LSD caused by Allerton virus, insect bite, bovine popular stomatitis caused by parapox virus, dermatophilosis, mite infestation, and besnoitiosis are also characterized by skin lesions to varying degree and could be considered as differentials based on skin lesions (Tuppurainen *et al.*, 2017, Hunter and Wallace, 2001). Despite the low mortality associated to LSD, the disease remains of major economic importance due to its associated economic losses (Hunter and Wallace, 2001). Economic losses attributed to LSD have been estimated using different model, for example in Turkey losses due to LSD was estimated to be 886.34 USD per animal in dairy cattle and 1066.61USD per animal in beef cattle per animal (Mat *et al.*, 2021). Estimation of economic loss has been done also in Kenya, and it was found to be USD 31 and per herd of indigenous cattle and USD 431 per herd of crossbreed cattle due to LSD associated mortalities and be USD 47 per herd and USD 266 per herd of indigenous and cross breed cattle respectively due to drop in milk production and losses related to additional veterinary costs in LSD affected herds was 37 USD per herd in indigenous breed cattle and 50USD per herd in cross breed cattle (Kiplagat *et al.*, 2020).

Drop in milk production, mastitis due secondary bacterial infection, abortion, loss of body condition affecting market value, infertility, damage of hide and increased veterinary costs

from treatment and vaccination are some of the losses linked to LSD (Gambo *et al.*, 2018, Kiplagat *et al.*, 2020).

LSD is mainly transmitted mechanically by blood feeding insects such as Mosquitoes (Chihota *et al.*, 2001), stable flies (*Stomoxys calcitrans*) (Kitching and Mellor, 1986) and tick especially the African tick species like *Rhipicephalus* and *Amblyomma* (Tuppurainen *et al.*, 2013). Suwankitwat *et al.* (2023) reported that the risk of LSD infection is lower in herds with vector control program compared to those without. However, the role of vectors in LSD transmission is poorly understood among farmers hence vector control may not be a priority (Hatami *et al.*, 2022). LSD transmission via direct contact is possible but considered ineffective (Kayesh *et al.*, 2020).

Vaccination is the most cost-effect control measure against LSDV. However, lack of reliable and cost-effective vaccine is a global challenge (Beard, 2016, Habiyaemye *et al.*, 2017) limiting LSDV control and calls for collaborative efforts to halt this transboundary disease (Beard, 2016). Practices such as introduction of new animals, communal grazing and watering points, source of replacement stock, season of the year and movement of animal are risk factors associated with LSD occurrence and transmission (Gari *et al.*, 2012, Tuppurainen *et al.*, 2017, Kiplagat *et al.*, 2019, Ochowo *et al.*, 2019).

Community awareness on LSD has been reported previously in South Africa and Nigeria (Habiyaemye *et al.*, 2017, Atai *et al.*, 2021). However, despite Tanzania being one of the largest cattle holders in Africa, and the long history of the disease in the country (Baldacchino *et al.*, 2013), the information on community knowledge, altitude and practice towards LSD is not documented. Therefore, the present study seeks to establish KAP towards LSD which is the first study of its nature in Tanzania.

## Material and Methods

### Study area

The study was conducted in Tanga and Pwani administrative regions in Tanzania. Tanga is located on 5.3050°S, 38.3166°E northeast of Tanzania bordering Kenya and Kilimanjaro in

the north, Manyara region to the west, Morogoro and Pwani region to the south and Indian ocean to the east. Tanga has a total area of 26667km<sup>2</sup> divided into 11 administrative districts. According to the national agricultural census 2019/2020, 23% of the household are involved in cattle keeping with a total of over 1.5million cattle (URT,2021) which makes livestock farming to be one of the key sources of income in Tanga. Pwani located on 7.3238°S, 38.8205°E has a total area of 32547 km<sup>2</sup> divided into eight (8) administrative districts and borders Tanga region to the north, Morogoro to the west, Lindi region to south and surrounds Dar es salaam to east. According to the national Agricultural census 2019/2020 (URT,2021), the region has a total of 739 101 cattle.

#### *Study design*

This cross-sectional study was conducted from December 2022 to February 2023. Multistage sampling method was employed where two district from each region and three wards from each district were purposively selected based on availability of different farming systems, geographical representativeness, accessibility, and willingness of livestock farmers to participate in the study following consultation with the district livestock officers. Ward livestock extension officers prepared sampling frame from list of households, organized logistics for data collection and systematic random sampling procedure was used to select households from the list.

#### *Data analysis*

Collected data was entered into Microsoft excel (2013) and analyzed with the help of Epiinfo statistical package version 7.2.5.0. (Centers for Disease Control and Prevention, Georgia, USA). Data was further analysed using descriptive statistics, proportions were summarized in tables. Knowledge score were calculated as a proportion (%) of respondents from each category of the selected variable who had knowledge on LSD signs, transmission, losses and control and those who perceived LSD impact, risk of occurrence and preventability.

These scores were used as outcomes to establish the association between selected socio-demographic factors and the observed knowledge and attitude by univariate logistic regression model at 95% confidence level and 5% p-value.

To collect information for KAP assessment, a close-ended questionnaire tool was used. Questionnaire was developed in English and administered by face-to-face interview to one household member (owner/representative) using Swahili language to which all respondents had a good proficiency. Responses were recorded in a prepared form manually. A total of 116 respondents were interviewed. All participants were residents of the study area and freely consented to participate in the study. Socio-demographic factors such as age, herd size, respondent's districts, respondent's time in livestock farming, education level, role in the household, main source of income, animal type and past experience of LSD in the herd were included in the questionnaire and its influence on the knowledge and attitude towards LSD were assessed.

#### **Results**

Majority of the respondents were male (81.9%, CI=73.67-88.43) of which adult aged 35-60years formed the largest proportion of the participants (65.52%, CI=56.12-74.10). Large number of respondents (92.42%) had attained formal education. Majority (81.03%) of the respondents had no formal employment and over half of the respondents (52.59%, CI 43.11-61.93) described livestock farming as main source of income. Large number of the respondents were owners (93.10% CI= 86.96-96.98) where over half of the respondents have been in livestock farming activities for 1-10years. Dual purpose cattle are dominant in the study area (58.76%, CI=48.70-67.39). Details of socio-demographic information are included in Table 1.

**Table 1***Socio-demographic and household characteristics*

<b>Variable</b>	<b>Category</b>	<b>Proportion (%)</b>	<b>CI</b>
Sex	Female	21(18.1)	11.57-26.33
	Male	95(81.9)	73.67-88.43
Age	18-34	13(11.21)	6.10-18.40
	35-60	76(65.52)	56.12-74.10
	>60	27(23.28)	15.93-32.03
Education level	None	9(7.76)	3.61-14.22
	Primary	60(51.72)	42.26-61.10
	secondary	42(36.21)	27.49-45.65
	Tertiary	5(4.31)	1.41-9.77
Marital status	Married	105(90.52)	83.67-95.17
	Divorced	0(0.0)	-
	Single	11(9.48)	4.83-16.33
Employment status	Formal employment	11(9.48)	4.83-16.33
	Unemployed	94(81.03)	71.71-87.72
	Retired	11(9.48)	4.83-16.33
Main source of income	Livestock farming	61(52.59)	43.11-61.93
	Others	55(47.41)	38.07-56.89
Time in livestock farming	1-10 years	62(53.45)	43.95-62.76
	11-20 Years	23(19.83)	13.28-28.25
	Life time activity	31(26.72)	18.95-35.74

Role in the household	Owners	108(93.10)	86.96-96.98
	Others	8(6.90)	3.02-13.14
Herd size	Large	49(42.94)	33.13-51.76
	Medium	44(37.93)	29.09-47.41
	Small	23(19.83)	13.00-28.05
Animal type	Dairy	48(41.24)	32.61-51.30
	Beef	0(0.0)	-
	Dual purpose	67(58.76)	48.70-67.39
Animal breed per herd	Cross	26(22.63)	15.33-31.35
	Indigenous	26(22.63)	15.33-31.35
	Mixed	56(54.75)	45.23-64.08

Our study findings reveal that, 88.79% (CI= 81.60-93.90) of respondents were aware of LSD. It was also found that, LSD signs and losses other than skin lesions and drop in milk production respectively, were poorly understood by respondent (Table 2). Furthermore, majority of the respondents were not aware of the role of biting vectors in LSD transmission only 4.72% understood. Respondents reported LSD

occurrence in both dry and rainy season and in cattle of all ages and production stages (Table 2). Only few respondents reported occurrence of disease in young cattle (31.75%, CI=20.48-44.69), old cattle (3.17%, CI=0.39-11.00) and in lactating cattle (3.17%, CI=0.39-11.00). Our study further revealed that, over 54% of the respondents experienced LSD previously (Table 2).

**Table 2**

*Result on Community knowledge towards LSD*

Variable	Response	Proportion (%)	95%CI
Awareness on LSD presence	Yes	103 (88.79)	81.60-93.90
	No	13 (11.21)	6.10-18.40
Knowledge on LSD Signs	Yes	100(86.93)	79.40-92.51
	No	15(13.04)	7.49-20.60
Known LSD signs	Skin lesion	64(60.38)	50.41-69.75

	Mortality	9(8.49)	3.96-15.51
	Milk drop	18(16.98)	10.39-25.50
	Abortion	5(4.72)	1.55-10.67
	Unaware	10(9.43)	4.62-16.67
Knowledge on LSD associated Losses	Yes	102(88.70)	81.45-93.84
	No	13(11.30)	6.16-18.55
Known LSD losses	Drop in milk production	75(69.44)	59.84-77.95
	Mortalities	12(11.11)	5.87-18.60
	Abortion	4(3.7)	1.02-9.21
	Increased veterinary cost	5(4.63)	1.52-10.57
	Damaged hide	3(2.87)	0.58-7.90
	Others	9(8.33)	3.88-15.23
Knowledge on LSD Transmission	Yes	90(78.29)	69.60-85.41
	No	25(21.74)	14.59-30.40
Known means of LSD transmission	Animal contact	84 (79.25)	70.28-86.51
	Blood feeding vectors	5 (4.72)	1.55-10.67
	Others	1(0.94)	0.02-5.14
	Unaware	16(15.09)	8.88-23.35
Knowledge on control	Yes	93(80.87)	73.48-87.61
	No	22(19.13)	12.39-27.52
Known on LSD control measures	Movement restriction	60 (64.52)	53.91-60.26
	Vaccination	13 (13.98)	7.66-22.72
	Vaccination and movement restriction	20(21.51)	13.66-31.24
Known blood feeding vectors	Ticks	47(40.87)	31.79-50.43
	Ticks, tsetse fly and other biting flies	63(54.78)	45.23-64.08
	Mosquitoes	3(2.61)	0.54-7.43
	Others	1(1.74)	0.21-6.14
Knowledge on seasons of LSD occurrence	Yes	73(63.48)	53.99-72.26
	No	42(36.52)	27.74-46.10
Season which LSD is common	Rainy season	39(53.42)	41.43-65.20
	Dry season	34(46.58)	34.80-58.63
Past LSD experience	Yes	63(54.78)	45.23-64.04
	No	52(45.22)	35.92-54.77
Group of animals affected	Young	20(31.75)	20.48-44.69

	Old	2(3.17)	0.39-11.00
	No specific group	39(61.9)	48.80-73.85
	Lactating	2(3.17)	0.39-11.00
Last LSD experience	Within 6 months	9(14.29)	6.75-25.39
	One year ago	14(22.2)	12.72-34.46
	Within two years ago	20(31.75)	20.58-44.69
	More than 2 years	20(31.75)	20.58-44.69

#### *Attitude and perception towards LSD*

Majority (86.09% CI) of respondents understood the impact of LSD and believed cattle can come up with LSD in the area (78.26%, CI 69.60-85.41). Additionally, majority believed free animal movement communal grazing and watering points to be important factors for LSD

transmission (Table 3). Surprisingly, the blood feeding vectors on LSD transmission the value of vector control to limit LSD were poorly understood (Table 3). Majority of respondents believed LSD prevented and believed vaccination is important tool in controlling LSD. However, a significant proportion of respondents perceived vaccination as scarce and unaffordable resource (Table 3).

**Table 3**

*Result on attitude of the respondents towards LSD*

<b>Variable/factor</b>	<b>Response</b>	<b>Percentage</b>	<b>95% CI</b>
LSD impact	Yes	99(86.09)	78.39-91.83
	No	16(13.91)	8.17-21.61
Animals are at risk of being LSD infected	Yes	90(78.26)	69.60-85.41
	No	25(21.74)	14.59-30.40
Communal grazing and watering ponds facilitate LSD transmission	Yes	91(79.13)	70.56-86.15
	No	24(20.87)	13.85-29.44
Free animal movement facilitate LSD transmission	Yes	84(73.04)	63.97-80.89
	Unaware	27(23.48)	16.08-32.29
	No	4(3.48)	0.96-8.67
Blood feeding arthropods play a role in LSD transmission	Yes	13(11.30)	6.16-18.55
	No	102(88.70)	81.45-93.84
All breeds of cattle are susceptible to LSD	Yes	44(38.26)	29.35-47.79
	No	32(27.83)	19.87-36.95

	Unaware	39(33.91)	25.35-43.33
LSD is preventable	Yes	84(73.04)	63.93-80.89
	No	31(26.96)	19.11-36.03
Control blood feeding insects is important for LSD control	Yes	16(14.04)	8.24-24.79
	No	98(85.96)	78.21-91.76
Vaccination against LSD is important	Yes	90(78.26)	69.60-85.41
	No	3(2.61)	0.54-7.43
	Unaware	22(19.13)	12.39-27.52
Available vaccine can effectively protect animals against LSD	Yes	61(71.76)	60.96-81.00
	No	24(28.24)	19.00-39.04
LSD vaccine are readily available	Yes	2(1.74)	0.21-6.14
	No	83(72.17)	63.05-80.13
	Unaware	30(20.09)	18.34-35.10
LSD vaccine are affordable	Yes	1(0.87)	0.02-4.75
	No	74(64.35)	54.88-73.06
	Unaware	40(34.78)	26.14-44.23

#### *Community practices towards LSD*

Our finding reveals that majority of the respondents were using acaricide to control blood feeding vectors, which were exclusively applied using small manual sprayers (100% CI 96.82-100). Practices such as introduction of new animals, communal grazing and communal watering points were commonly observed (Table

4). Natural breeding dominated the breeding system and sharing of breeding bull was not uncommon practice. None of the participant had history of vaccinating animals against LSD in the study area. Use of antibiotics and anti-inflammatories in LSD affected cattle as supportive therapy was a common practice (Table 4).

**Table 4**

*Results on community Practice towards LSD*

Practice	Response	Proportion (%)	95% CI
Use of acaricide	Yes	114(99.13)	95.25-99.98
	No	0.87	0.02-4.75
Acaricide application	Home spraying	114(100)	96.82-100
	Others	0(0)	-
New animal introduction	Yes	34(29.57)	21.42-38.79
	No	81(70.43)	61.21-78.58
Grazing system	Communal grazing	69(60)	49.57-68.21

Watering system	Others	46(40)	30.98-49.55
	Piped/own source	59(51.3)	41.81-60.73
	Communal	56(44.70)	39.27-58.19
LSD vaccination	Yes	0.00	-
	No	116(100)	96.87-100
Breeding system	Artificial insemination	20(17.39)	10.96-25.57
	Natural by breeding bulls	94(81.74)	73.45-88.33
	Both	1(0.87)	0.02-4.75
Source of breeding bulls	Own	57(60.64)	50.02-70.56
	Shared	37(39.36)	29.44-49.98
Source of replacement stock	Own	104(90.43)	83.53-95.13
	Purchase	3(2.61)	0.54-7.43
	Both	8(6.96)	3.05-13.25
Treatment of LSD sick animals	Yes	63(98.44)	91.60-99.96
	No	1(1.56)	0.04-8.40

#### KAP score towards LSD

Table 5 shows the knowledge score on LSD signs, transmission, control and losses and the scores on attitude towards LSD on its impact, risk of

occurrence in the study area and preventability are indicated in table 6.

**Table 5**

*Knowledge scores on LSD signs, transmission, control and losses*

Variable	Category	Knowledge score (%) on LSD			
		Symptoms	Transmission	Control	Losses
Age	Young	8(61.54)	7(53.85)	8(61.54)	8(61.54)
	Adult	69(92.00)	70(93.33)	62(82.67)	70(93.33)
	Old	23(85.19)	24(88.89)	20(72.07)	24(88.89)
Sex	Male	82(87.23)	74(78.72)	77(81.91)	82(87.23)
	Female	18(85.71)	16(76.19)	16(76.19)	20(95.24)
Education level	Primary	54(93.10)	47(81.03)	47(81.03)	54(93.10)
	Secondary	35(81.04)	33(76.74)	35(81.04)	37(86.05)
	Tertiary	3(60.00)	3(60.00)	3(60.00)	3(60.00)
	None	8(88.89)	7(77.78)	8(88.89)	8(88.89)
Herd size	Small	15(68.18)	8(36.36)	11(50.00)	15(68.18)
	Medium	38(86.36)	36(81.82)	37(84.07)	39(88.64)
	Large	47(97.92)	46(93.88)	45(91.84)	48(97.96)
	owner	95(88.79)	86(80.37)	90(84.11)	97(90.65)

Role in the household	others	5(62.50)	4(50.00)	3(37.50)	5(62.50)
Main source of Income	Livestock	54(88.52)	50(81.97)	51(85.00)	55(90.16)
	Others	46(85.19)	40(74.07)	42(76.36)	47(87.04)
District	Pangani	52(96.30)	44(81.48)	46(88.86)	52(96.30)
	Tanga city	16(61.54)	14(53.85)	14(53.85)	18(69.23)
	Mkuranga	17(94.44)	16(88.89)	15(83.33)	17(94.44)
	Kisarawe	15(88.24)	16(94.12)	16(94.12)	15(88.24)
Time in livestock farming	1-10 years	48(78.69)	39(63.93)	41(67.21)	49(80.33)
	10-20 years	23(95.83)	22(91.67)	24(100)	24(100)
	Lifetime	29(96.67)	29(96.67)	28(93.33)	29(96.67)

**Table 6***Scores on attitude towards LSD impact, risk of occurrence*

Variable	Category	Attitude score (%) on LSD		
		Impact	Risk of infection	Preventability
Age	Young	9(69.23)	7(53.85)	6(46.15)
	Adult	68(90.67)	61(81.33)	55(73.33)
	Old	22(81.48)	22(81.48)	23(85.19)
Sex	Male	81(85.26)	75(78.95)	69(72.63)
	Female	18(90.00)	15(75.00)	15(75.00)
Herd size	Small	15(65.22)	10(43.48)	7(30.47)
	Medium	37(84.09)	34(77.27)	33(75.00)
	Large	47(97.92)	46(96.83)	44(91.67)
Role in the household	Owners	94(87.85)	86(80.37)	80(74.77)
	Others	5(62.50)	4(50.00)	4(50.00)
Source of income	Livestock	55(88.52)	50(81.97)	49(80.33)
	Others	45(83.33)	40(74.07)	35(64.81)
Animal type	Dairy (cross)	34(72.34)	29(61.70)	30(63.83)
	Dual- purpose	65(95.59)	61(89.71)	54(79.41)
Past LSD Experience	Yes	60(95.24)	60(95.24)	52(82.54)
	No	39(75.00)	30(57.69)	32(61.54)
District	Pangani	51(92.73)	48(87.27)	38(69.09)
	Tanga city	15(60.00)	13(52.00)	14(56.00)
	Mkuranga	17(94.44)	16(88.89)	16(88.89)
	Kisarawe	16(94.12)	13(76.47)	16(94.12)

*Factors associated with community knowledge and attitude towards LSD*

The findings of our study show that, knowledge on LSD signs was significantly associated with respondent age, herd size, experience in livestock farming and respondent district. Lower odds of knowledge on LSD signs, transmission, control and LSD related losses were associated with young age and districts of residence (Tanga city

council), alternative source of income and non-owner role in the household (Table 7)

On the other hand, odds for LSD knowledge were higher in respondents with large number of animals (large and medium herd sizes), long time (11-20 years and lifetime) engagement in livestock farming (Table 7).

**Table 7**

*Factors associated with knowledge towards LSD*

Factor	Category	OR	95% CI	P value
<b>Factors associated with knowledge towards LSD signs</b>				
Age	>60 years	0.50	0.13-1.93	0.314
	18-34	0.14	0.03-0.56	0.005*
	35-60 years	-	-	Reference
Sex	Female	0.88	0.22-3.44	0.852
	Male	-	-	-
Education level	Primary	1.69	0.167-17.06	0.658
	Secondary	0.55	0.05-5.06	0.594
	Tertiary	0.19	0.01-2.91	0.231
	None	-	-	Reference
Herd size	Medium	3.00	0.85-10.25	0.088
	Large	10.97	2.05-58.57	0.005*
	Small	-	-	Reference
Role in the household	Others	0.21	0.04-0.99	0.059
	Owner	-	-	Reference
Main source of income	Others	0.75	0.25-2.21	0.597
	Livestock farming	Ref	Ref	Ref
	Others	0.98	0.22-4.21	0.982
Time in livestock farming	10-20 years	6.23	0.77-50.55	0.087
	Lifetime	7.85	0.98-63.31	0.005*
	1-10 years	-	-	Reference
District	Tanga city	0.06	0.01-0.31	0.001*
	Mkuranga	0.65	0.06-7.67	0.735
	Kisarawe	0.29	0.03-2.22	0.233
	Pangani	-	-	Reference
<b>Factors associated with knowledge score on LSD transmission</b>				
Age	>60 Years	1.09	0.32-3.74	0.885
	18-34 Years	0.22	0.06-0.77	0.019*
	35-60 Years	-	Reference	-
Sex	Female	0.71	0.23-2.20	0.548
	Male	-	Reference	-
Education level	Primary	0.53	0.06-4.73	0.573
	Secondary	0.55	0.06-5.02	0.594
	Tertiary	0.19	0.021-2.91	0.232

Herd size	None	-	Reference	-
	medium	5.29	1.65-16.9	0.005*
	Large	11.25	3.00-42.12	0.003*
Role in the household	Small	-	Reference	-
	Others	0.11	0.02-0.52	0.005*
	Owner	-	-	Reference
Main source of income	Others	0.57	0.22-1.46	0.005*
	Livestock farming	-	-	Reference
Time in Livestock farming	11-20years	1.00	0.002-0.19	0.9657
	Lifetime	6.83	1.48-31.56	0.014*
	1-10years	-	-	Reference
District	Tanga city	0.15	0.05-0.46	0.001*
	Mkuranga	0.62	0.14-281	0.550
	Kisarawe	1.99	0.22-17.78	0.537
	Pangani	-	-	Reference
<b>Factor associated with knowledge score on LSD control</b>				
Age	>60years	0.60	0.21-1.71	0.338
	18-34	0.33	0.09-1.19	0.091
	35-60	-	-	Reference
Sex	Female	0.86	0.28-2.65	0.799
	Male	-	-	Reference
Education level	Primary	0.57	0.218-1.492	0.253
	Secondary	1.22	0.22-6.70	0.819
	Tertiary	0.94	0.17-5.28	0.947
Herd size	None	-	-	Reference
	Large	26.83	6.25-115.02	0.000*
	Medium	7.88	2.47-25.88	0.001*
Role in the household	Small	-	-	Reference
	Others	0.244	0.06-1.06	0.059
	Owner	-	-	Reference
Main source of income	Others	0.63	0.26-1.53	0.308
	Livestock farming	-	-	Reference
Time in livestock farming	11-20years	6.21	1.33-28.91	0.020*
	Lifetime	16.14	2.08-128.18	0.008*
	1-10years	-	-	Reference
District	Tanga city	0.27	0.09-0.74	0.012*
	Mkuranga	1.82	0.36-9.21	0.470
	Kisarawe	3.64	0.43-30.71	0.236
	Pangani	-	-	Reference
<b>Factor associated with knowledge score on losses attributed to LSD</b>				
Age	>60	0.57	0.13-2.57	0.466
	18-34	0.11	0.03-0.48	0.003*
	35-60	-	-	Reference
Sex	Female	2.92	0.36-2381	0.316
	Male	-	-	Reference
Education level	Primary	1.69	0.17-17.06	0.658
	Secondary	0.77	0.08-31	0.820

	Tertiary	0.18	0.01-2.91	0.231
	None	-	-	Reference
Herd size	Large	22.38	2.54-196.67	0.005*
	Medium	3.64	1.00-13.26	0.050*
	Small	-	-	Reference
Role in the household	Others	0.17	0.04-0.83	0.028*
	Owners	-	-	Reference
Main source of income	Others	0.73	0.23-2.33	0.598
	Livestock farming	-	-	Reference
Time in livestock farming	11-20years	1.00	0.01- 13.04	0.972
	Lifetime	7.10	0.88-57.48	0.0661
	1-10years	-	-	Reference
District	Tanga city	0.09	0.02- 0.44	0.003*
	Mkuranga	0.67	0.06-7.67	0.735
	Kisarawe	0.28	0.03-2.22	0.233
	Pangari	-	-	Reference

\* Value significant at  $p \leq 0.05$

It was further observed that, respondents owning dual-purpose cattle, large number of cattle (large and medium herd size) and with previous experience of LSD in their herds had higher odds of attitude score on LSD impact, risk of LSD

occurrence and preventability. Contrary to that, respondents aged below 35 years old and respondents from Tanga city council appeared to have lower odds of perception score (Table 8).

**Table 8**  
*Factors associated with attitude and perception towards LSD*

Factor	Category	OR	95%CI	P-value
<b>Factors associated with attitude and perception towards LSD impact</b>				
Age	>60years	0.59	0.16-2.21	0.435
	18-34	0.23	0.05-0.95	0.042*
	35-60	-	-	Reference
Sex	Female	0.21	0.30-6.87	0.659
	Male	-	-	Reference
Role in the household	Others	0.21	0.04-1.00	0.049*
	Owner	-	-	Reference
Education level	Primary	0.80	0.09-7.25	0.840
	Secondary	1.19	0.11-12.09	0.881
	Tertiary	0.19	0.01-2.91	0.232
	None	-	-	Reference
Herd size	Large	25.02	2.89-216.24	0.003*
	Medium	3.38	1.00-11.34	0.050*
	Small	-	-	Reference
Animal type	Due purpose	12.07	2.58-56.54	0.002*
	Dairy breed	-	-	Reference
Past LSD experience	Yes	9.99	1.59-22.55	0.008*
	No	-	-	Reference
District	Tanga city	0.14	0.04-0.51	0.003*

	Mkuranga	1.33	0.14-12.74	0.803
	Kisarawe	1.25	0.13-12.04	0.844
	Pangani	-	-	Reference
<b>Factor associated with attitude and perception score on LSD infection risk</b>				
Age	>60	1.01	0.33-3.13	0.987
	18-34	0.23	0.08-0.92	0.037*
	35-60	-	-	Reference
Sex	Female	0.80	0.26-2.47	0.698
	Male	-	-	Reference
Herd size	medium	4.4	1.49-13.07	0.007*
	Large	29.89	5.81-153.80	0.000*
	Small	-	-	Reference
Role in the household	Others	0.24	0.06-1.06	0.059
	Owner	-	-	Reference
Income source	Others	0.63	0.26-1.53	0.308
	Livestock farming	-	-	-
Animal type	Dual purpose	2.28	0.98-5.31	0.05*
	Dairy	-	-	-
Past LSD experience	Yes	14.67	4.06-52.92	0.000*
	No	-	-	Reference
District	Tanga city	0.16	0.05-0.148	0.001*
	Mkuranga	1.17	0.22-6.20	0.857
	Kisarawe	0.47	0.12-1.87	0.287
	Pangani	-	-	Reference
<b>Factor associated with attitude and perception score on LSD preventability</b>				
Age	>60years	1.95	0.60-6.34	0.268
	35-60years	-	-	Reference
	18-34years	0.29	0.09-0.97	0.045*
Sex	Female	1.07	0.35-3.25	0.903
	Male	-	-	Reference
Role in the house hold	Others	0.32	0.08-1.38	0.1260
	Owner	-	-	Reference
Source of income	Others	0.41	0.17-0.96	0.039*
	Livestock farming	-	-	-
Herd size	Large	20.58	5.48-78.18	0.000*
	Medium	5.68	1.88-16.84	0.000*
	Small	-	-	Reference
Animal type	Dual purpose	2.28	1.00-5.31	0.057
	Dairy	-	-	Reference
Past LSD experience	Yes	2.72	1.15-6.44	0.022*
	No	-	-	Reference
District	Tanga city	0.52	0.20-1.39	0.194
	Mkuranga	3.28	0.68-15.95	0.141
	Kisarawe	6.56	0.80-53.72	0.079
	Pangani	-	-	Reference

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\* Value significant at  $p \leq 0.05$

### Discussion

The present study which is the first in Tanzania has established factors associated with knowledge and attitude towards LSD in Tanga and Pwani regions. Majority of the respondents were male, suggesting that livestock farming in Tanzania is male dominated and is in agreement with previous studies by (Habiyaremye *et al.*, 2011). This can be explain by the tradition and culture of most of African societies where male have a responsibility of taking care of animals and making decision of various family matters. Literate respondents affirms their ability to adapt to new technologies in livestock farming and disease control.

Majority of the respondents were adult aged above 34 years, which is in agreement with previous studies (Mlozi *et al.*, 2015, Habiyaremye *et al.*, 2011; Ngoshe *et al.*, 2023). Lack of capital and motivation among young individuals to get engaged in livestock farming could be the reason for their low number. It can also be speculated that young individuals are still looking for jobs with monthly wages before they can invest in livestock farming activities.

Over half of the respondents described livestock farming as a main source of their income which is similar to the findings reported previously (Ngoshe *et al.*, 2023). This finding justifies the importance of livestock farming in household economy and towards poverty alleviation, food security and sustainable livelihood in Tanzania.

Furthermore, large number of respondents appeared to have engaged in livestock farming activities within past 10 years. This can be explained by high unemployment rate and population growth which increases demand for animal source proteins as allude to by Mlozi *et al.* (2015). Therefore, the livestock sector in Tanzania has potential for employment creation subject to supportive environment such as improved veterinary service, pasture resource and ensuring reliable market for livestock products.

In the present study, majority of the respondents in the surveyed area were aware of lumpy skin

disease which agrees with the findings reported early by Atai *et al.* (2021). This suggests that LSD possibly continue to be a production challenge in cattle since its first outbreak in 1981 and 1986 (Baldacchino *et al.*, 2013). However, majority of the respondents described LSD based on skin lesions (nodule) only from which different tribes assigned LSD local dialect names such as *mapele ngozi* (Swahili language), *malutu* (in Tanga), *Ovevedoi* (Maasai) and *nyawishita/tangulu* (Barabaig), all of them meaning big rashes. This is in agreement with the findings reported in by Gambo *et al.* (2018), Atai *et al.* (2021) and Ngoshe *et al.* (2023). On the other hand, the current finding is suggesting limited knowledge on signs other than skin lesions which in turn can lead to misreporting due to confusion with differential diseases characterized by skin lesion as documented by Tuppurainen *et al.* (2017). Retooling on differential diagnosis through extension services is recommended.

Drop in milk production was the most frequent reported economic loss attributed to LSD, and confirmed in previous studies (Gambo *et al.*, 2018, Kiplagat *et al.*, 2019). Increased milk demand and market availability possibly due to presence of milk processing plants like Tanga fresh, Dar fresh and ASAS with well-established milk collection centers in different parts of the country is speculated to increase farmers sensitivity and awareness on milk loss. Other losses such as from permanent damage of hide and increased veterinary cost were poorly understood by majority of the respondents which could be due to low value of hide and poor record keeping in traditional farming system.

Furthermore, respondents attributed animal movement and contact between animals as main means for LSD transmission but were not privy to the role of vector in LSD epidemiology (Tuppurainen *et al.*, 2017, Kayesh *et al.*, 2020). This agrees with the previous study in Iran (Hatami *et al.*, 2022). Lack of knowledge on vector management in LSD control requires attention to build competence among stakeholders.

More than a half (54.78%) of the respondents appeared to have past experience of LSD in their

herds. This proportion is slightly lower than the over 64% reported in Nigeria by Gambol *et al.* (2018). In our study, the number of respondents who mentioned LSD occurrence in dry and rain season was very close suggesting the possibility of LSD occurrence throughout the year in the study area.

Majority of the respondents mentioned occurrence of LSD in cattle of all ages and production stages. However, few respondents reported to observed LSD in specific animal groups such as young animals, old animals and lactating animals only, which agree with the previous studies (Abera *et al.*, 2015, OIE, 2021). Occurrence of LSD in young animals is associated with incompetency of the immune system due to low exposure while occurrence in old animals and lactating animals can be linked to production stresses and possibly increased exposure.

Majority of the respondents (86.09%) believe LSD had great economic impact. Findings of similar nature have been documented previously in Nigeria (Gambo *et al.*, 2018). This indicate the possibility of LSD to be among the setback to cattle productivity in many areas in Africa. Moreover, respondents highlighted the role of vaccination in LSD control but there are concerns on limited access and high cost of the vaccines that hinder their use (Habiyaemye *et al.*, 2017, Suwankitwat *et al.*, 2023). This observation mirrors findings in South Africa where LSD vaccine is regarded as expensive (Habiyaemye *et al.*, 2017). This suggest the need for government agencies and scientist to ensure cost effective vaccine is developed and available to farmers.

Our study further observed the use of acaricide by majority of the respondents. This indicate the willingness of farmers to control vectors which is also suggested for LSD control especially during outbreaks (Issimov *et al.*, 2020, Suwankitwat *et al.*, 2023). High prevalence of vectors is conceivably the major driver for the extensive use of acaricides rather than targeting LSD control. Despite the commitment of farmers to use acaricide, the process was very challenging due to lack of dipping facilities therefore, acaricide were applied manually leading to doubtful efficiency of the process especially in households with large cattle herds.

Some practices such as introduction of new animals, sharing of grazing areas, watering points and breeding bulls were common are risk factors for LSD occurrence (Hasib *et al.*, 2021). These practices are driven by pasture scarcity and poor knowledge on LSD transmission. There were no reports of LSD vaccination among study respondents implying that the cattle population are at risk of LSD infection.

Majority of the respondents used antibiotics and anti-inflammatory drugs as a supportive therapies to animals showing LSD sign, which is parallel to the findings reported by Bett *et al.* (2008). The use of antibiotics observed does not only add to veterinary costs, but also threaten the national and global public health by contributing to increased risk of antimicrobial resistance. Its therefore important to stress on preventive measures such as vaccination and vector control.

Furthermore, our study reports on factors that influenced knowledge and attitude towards LSD in the study area where respondent age, role in the household, main source of income, herd size, residence district, time in livestock farming, animal type and previous LSD experience in the herd to be important factors for both community knowledge and attitude towards LSD.

Lower odds of knowledge and attitude on LSD were associated with young age which is in agreement with the findings reported by Ngoshe *et al.* (2023). This is likely due to lack of interest in livestock farming activities and limited time of exposure in this age group with a possibility that they have never come across LSD.

Respondents from Tanga city council also appeared to have significantly lower odds of knowledge and perception compared to Pangani, Mkuranga and Kisarawe districts. This can be linked to environmental factors and management practice in the city settings that narrow down the possibility of LSD occurrence. Large number of people in the city leading to increased human activities that interferes with the breeding and resting places for vectors, the key players in LSD epidemiology, hence low exposure in the city (Malele *et al.*, 2011).

Moreover, respondents other than owner also appeared to have lower odds of knowledge and perception on LSD than owners. Resource commitment and return expectation from the livestock project by the owner, possibly differentiate from other family members (Mlozi *et al.*, 2015). The owner can directly feel the cost and losses attributed to disease which is likely to influence awareness of various animal diseases.

Interestingly, respondents with activities other than livestock farming as their main source of income had lower odds of knowledge on LSD. This can be explained by differences in levels of dependence on livestock for household need. These findings give the impression that, respondents with no alternative source of income other than livestock are likely more attached to their animals and aware of different condition that can affect animals.

Our study further reveals that, respondents with large number of cattle, long history in livestock farming and those with dual-purpose cattle type had significantly higher odds of knowledge and attitude. This can be explained by the possibility of previous exposure to LSD. Being engaged in livestock farming for long time likely make farmers more familiar with different livestock diseases as documented previous by Anne *et al.* (2020). With herd size and animal type, variation in management practice is thought to influence the exposure rate to diseases and hence awareness. Due to large feed requirement, farmers with large number of cattle, in most cases graze their cattle in communal areas where there is increased exposure (Gari *et al.*, 2010). Similarly dual-purpose cattle, in most cases are indigenous cattle that are believed to be resistant to most diseases (Vordermeier *et al.*, 2012). They are therefore, less protected from diseases. Increased exposure and possibly increased frequency of LSD occurrence is linked to the observed high odds of knowledge and attitude

Additionally, respondents with previous LSD experience in the herd had specifically higher

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perception score on LSD impact, infection risk and preventability. This is in agreement with the previous studies (Hatami *et al.*, 2022) where experience on diseases and associated losses appeared to influence attitude and willingness to control diseases.

#### Conclusion

Farmers are familiar with LSD occurrence suggesting its importance in livestock production. However, LSD signs, transmission, control and losses were poorly understood by farmers.

#### Recommendations

Therefore, extension programmes for education and awareness creation are required for farmers to understand the disease and authorities should consider planning and implementation of effective control program including making cost effective vaccine available and construction of dipping facilities for vector control. Further studies should also be conducted to confirm the presence of the responsible virus and to understand the epidemiology of this disease in Tanzania.

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#### Ethical Clearance

Granted by Research Ethics Committee at Sokoine University of Agriculture with approval number SUA/DPRTC/R/186/031. All participants freely consented to participate in this study.

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## CHAPTER FOUR

### 4.0 GENERAL DISCUSSION, CONCLUSION AND RECOMMENDATIONS

#### 4.1 General Discussion

The present study has detected lumpy skin disease virus (LSDV) antibodies in the study area and has generated epidemiological information by establishing seroprevalence of 13.5% and 22.75% at animal and herd level, respectively. It further establishes age, breed, grazing system, herd size, source of breeding bull, location and introduction of new animals as risk factors for LSD occurrence. This study has also established the community knowledge, attitude and practice towards LSD in Tanga and Pwani regions in Tanzania.

The observed seroprevalence varied from the prevalence established previously in other countries for example at animals level, lower prevalence than the current findings of 8.1%, 6.4%, 7.6% established in Ethiopia and 8.7% in Uganda (Gari *et al.*, 2010, Abera *et al.*, 2015, Ochowo *et al.*, 2019, Hasib *et al.*, 2021) and prevalence higher than in the present study(19.5%) has been reported in Egypt (Selim *et al.*, 2021). The herd level prevalence reported in this study is lower than 72.3% reported in Uganda but close to 20.8% reported previously in Ethiopia (Ochowo *et al.*, 2019, Dubie *et al.*, 2022). The effect of variation in geographical location, climatic conditions and the season on different drivers of diseases including vector population is linked to the observed findings. Variability in study design and testing method may also be behind the observed difference in prevalence.

Anti-LSDV were not detected in all tested sera from Tanga city council, which indicate limited exposure of animals to LSDV in this area. This is possibly due to low prevalence of biting insect influenced by increased human activities in the city settings which interfere with breeding and hence prevalence of vectors leading to low exposure (Malele *et al.*,

2011). Management system where by-laws restrict animal movement in the city also can contribute to low exposure. Prevalence also appeared vary between districts which agrees with previous studies reported by Gari *et al.* (2012). This further justifies that animals are possibly exposed at different rates between districts which can be due to difference in prevalence and distribution of vectors.

On assessment of risk factors, the finding showed a significant variation in prevalence with age, breed, grazing system, source of breeding bull, herd size, location and introduction of new animals. Similar factors appeared to have significant association with the seropositivity and therefore are risk factors.

Cattle aged >4 years appeared to be at increased risk to LSDV infection compared to calves which is parallel to early reports (Ochowo *et al.*, 2019, Selim *et al.*, 2021, Amin *et al.*, 2021). High prevalence and infection risk in old animals is linked to increased exposure to LSDV, unlike in calves where in most cases are kept separately and protected from exposure to disease causing agents. Presence natural passive immunity in calves due to possible endemicity of LSD in the area can also be associated with the observed findings. The findings of this study revealed increased likelihood to LSD infection in animals from rural area. This can be explained by environmental factors including presence of large unoccupied land that favor the breeding and hence prevalence of vectors, the key players in the LSD epidemiology.

Communal grazed and cattle from large herd size were significantly associated with LSD positivity. These findings are in line with previous reports (Gari *et al.*, 2010, Selim *et al.*, 2021, Dubie *et al.*, 2022). High risk in communal grazed animal is linked to the possibility of mixing animals and increased contact of animals with different health status from different herds which is likely to facilitate transmission. While

higher odds in large herd size is possibly due to lack of pasture to accommodate large number of animals that cause starvation where especially during the dry season animals are tracked long distances searching for pasture. Starvation and long-distance tracking are stressful to animals which can increase the susceptibility to disease. Contrary to the previous studies (Kiplagat *et al.*, 2020, Hasib *et al.*, 2021) where crossbreed and pure breed cattle appeared to be at increased risk to LSD infection, the present study revealed increased risk in indigenous breed that support the findings reported in Uganda (Ochowo *et al.*, 2019). This can be explained by differences in management practices between breeds where indigenous breed cattle are considered hard and resistance to diseases therefore, management levels are not stringent as in crossbreed which are regarded delicate and more susceptible to disease and hence more protected than indigenous breed.

Furthermore, history of introducing new animals in the herd and sharing of breeding bull had significant association with the serostatus. Association between seropositivity and introduction has been reported also in early studies (Amenu, 2018, Issimov *et al.*, 2020). This is possibly due to introduction of new animals or breeding bulls which are incubating virus with subclinical diseases especially with lack of rapid and cost-effective diagnostic services for screening animals before introducing in the herd and failure to quarantine new animals before introducing in the herd. When a newly introduced animal is infected, will possibly serve as source of virus to the resident biting insect which will mechanically transmit virus in the herd.

The findings on KAP assessment towards LSD, like in the previous studies (Atai *et al.*, 2021), majority of the respondents were aware with LSD which suggest that the disease is possibly endemic and is among the causes of low productivity of livestock and probly diseases in the study area. However, LSD signs, lossess transmission and control were poorly understood by farmers in the study area.

Majority of the respondents were aware only with skin lesions (nudules) as the only clinical sign. This is consistent with the finding reported by Gambo *et al.* (2018), Atai *et al.* (2021) and Ngoshe *et al.* (2023) and therefore, different tribes named the disease base on skin lesion such as *mapele ngozi* (Kiswahili language), *malutu* (in Tanga), *Ovevedoi* (Maasai) and *nyawishita/tamgulu* (Barabaig) meaning big rashes of the skin. The finding is suggesting limited knowledge on signs other than skin lesions which can affect diagnosis and reporting since there are other diseases such as pseudopox, dermatophilosis and urticaria which are also characterized by lesion on the skin.

Drop in milk production was the most reported economic loss attributed to LSD. This is in line with the previous studies (Gambo *et al.*, 2018, Kiplagat *et al.*, 2019) who reported significant drop in milk following LSD infection. Increased milk demand and market availability possibly due to presence of milk processing plants like Tanga fresh, Dar fresh and ASAS is speculated to increase farmers' sensitivity and awareness on milk loss. Losses such as damaged hide and increased veterinary cost were poorly understood by majority of the respondents which may be due to low value of hide and traditional farming where treatment and other management costs are rarely recorded.

It was further found that animal movement and contact were regarded as the main means for LSD transmission contrary to the findings reported previous (Tuppurainen *et al.*, 2017, Kayesh *et al.*, 2020) who documented vectors as the LSD principal transmitters. Interestingly, despite the observed awareness on presence of blood feeding vectors (100%), majority of the interviewed farmers failed to understand the role of blood feeding insects in LSD transmission which is consistent with the previous study in Iran (Hatami *et al.*, 2022). This indicates the importance of awareness creation for better control of the disease.

More than half (54.78%) of the respondents in this study had past experience of LSD in their herds which is lower than the over 64% reported in Nigeria by Gambo *et al.* (2018). The number of respondents who mentioned LSD occurrence in dry and rain season was very close agreeing with previous findings (Atai *et al.*, 2021). This suggests the possibility of LSD occurrence throughout the year in the study area. Majority of the respondents mentioned occurrence of LSD in all animal groups. However, few respondents reported to observed LSD in specific groups such as young animals, old animals and lactating animals only which is parallel to the previous studies (Abera *et al.*, 2015, OIE, 2021). Occurrence of LSD in young animals is associated with incompetency of the immune system while occurrence in old animals and lactating animals can be linked to production stresses.

LSD impact were perceived by majority of the respondents which is consistent with previous findings (Gambo *et al.*, 2018). In the present study, respondents believed the disease can be prevented and had attitude that vaccine is an important tool in the fight against LSD which is parallel with findings (Habiyaremye *et al.*, 2017, Issimov *et al.*, 2020). This shows the willingness of the respondents to control LSD, however, the perception of majority of the respondents was that vaccine is not readily available and unaffordable. This shows that LSD control is a challenge if cost-effective vaccine against LSD is not made available.

The current study observed the use of acaricides by majority of the respondents. This justifies further the willingness of farmers to control vectors which is also suggested for LSD control especially during outbreaks (Issimov *et al.*, 2020). Possibly high prevalence of vectors is the major driver for the extensive use of acaricides. However, despite the commitment in acaricide use, the process was very challenging due to lack of dipping facilities therefore, acaricides were applied manually leading to questionable efficiency of the process.

Some contradictory practices including introduction of new animals, sharing of grazing areas and watering ponds and sharing of breeding bulls were not uncommon. These practices have been reported previously to facilitate transmission and occurrence of LSD (Hasib *et al.*, 2021). Lack of pasture and lack of knowledge on the role of different practices are the possible reasons for the observed practices. With the observed contradictory practices, vaccination against LSDV could be the best control option as suggested previously (Beard, 2016), surprisingly none of the household had vaccinated animals against LSD implying that cattle population in the study area is at risk of getting infected with LSDV.

Majority of the respondents used antibiotics and anti-inflammatory drugs to treat animals with LSD sign which is parallel to the findings reported by Bett *et al.* (2008). The use of antibiotics does not only add to veterinary costs, but also threaten the national and global public health by increasing risk of antimicrobial resistance.

The observed KAP towards LSD were significantly associated with Age of the respondent, district, role in the household, main source of income, size of the herd owned, time in livestock farming, Past LSD experience and animal type.

Lower knowledge score on LSD associated with young age which is in agreement with the findings reported by Ngoshe *et al.* (2023). Limited time of exposure in livestock farming could be the reason for the observed result.

Similarly, respondents from Tanga city council also appeared to have significantly lower odds of knowledge and perception rate compared to Pangani, Mkuranga and Kisarawe districts. This can be linked to environmental factors and management practice in the city settings that possibly make rare occurrence of LSD. Large number of people in the city leading to increased human activities that interferes with the

breeding and resting places for vectors that are important in LSD transmission, hence low exposure in the city. Moreover, due to increased human activities in the Tanga city, there is limited availability of unoccupied land to allow outdoor grazing such as communal grazing, it is therefore likely that animals in Tanga city council are mostly zero-grazed which adds to the reduced risk of exposure to diseases including LSD and making people less aware of its occurrence and impact.

Moreover, respondents other than owner also appeared to have lower odds of knowledge and perception rate on LSD than owners. Difference in responsibilities, resource commitment and return expectation from the livestock project between different members in the household as documented previously (Mlozi *et al.*, 2015) could be behind the observed findings. Since owner has committed resources to the cattle project, therefore the impact of losses and diseases is felt direct by the owner which increase the awareness and sensitivity different from other household members who cannot mostly feel the impact directly. Interestingly, respondents with activities other than livestock farming as their main source of income had lower odds of knowledge on LSD. This can be explained by differences in levels of dependence on livestock for household need which possibly determine the level of awareness on different condition on animals with higher odds in those who solely depend on livestock farming.

On the other hand, respondents with large number of animals and long history in livestock farming had significantly higher odds of knowledge and positive perception rate unlike in respondents with small number of animals and recent history in livestock farming. Perhaps experience on livestock conditions by individual with long time involvement in livestock farming as documented early by Anne *et al.* (2020) and increased possibility of exposure to LSD virus in large herd sizes due management practice where in most cases animals in large herd size are grazed outdoor in communal grazing areas where there is increased exposure and possibly LSD occurrence as reported previously Gari *et al.* (2010).

Additionally, respondents with previous LSD experience in the herd and dual-purpose animals had high perception score on LSD impact, infection risk and preventability. This is in agreement with the previous studies (Hatami *et al.*, 2022) where experience on diseases and associated losses appeared to influence attitude and willingness to control. In most cases dual purpose cattle are indigenous breed which are regarded resistance to most disease hence is less protected and probably have increased exposure to LSDV leading to losses which increase farmers awareness.

#### **4.2 General Conclusion**

To the best of our knowledge, this is the first study to establish the seroprevalence, risk factors for LSD occurrence of LSD and the community knowledge, attitude and practice (KAP) towards LSD in Tanzania. The study has established LSD seroprevalence of 13.5% and 22.73% at animal and herd level, respectively and established age, breed, grazing system, herd size, source of breeding bull, location and introduction of new animals as risk factors for LSD occurrence in the study area. The study has further established limited knowledge on LSD clinical signs, losses, transmission and control and observed Respondent age, district, role in the household, main source of income, size of the herd owned, time in livestock farming, Past LSD experience and animal type to have influence on the KAP towards LSD.

#### **4.3 General Recommendations**

- i. Further studies to confirm and understand the molecular epidemiology of the responsible virus is important.
- ii. Further studies to establish the burden of LSD country wide is important for better planning and implementation of effective control measures.
- iii. Extension knowledge to farmers on LSD risk factors, signs, associated losses, transmission and control is also important for successful control of the disease.

- iv. Government should include LSD in the list of priority diseases and strengthen the control program including establishing diagnostic facilities and reporting system.
- v. Researchers and government should consider developing cost effective vaccine locally against this economically important disease (LSD).

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## APPENDICES

## Appendix 1: Sample information for seroprevalence

	Sex	Age	Breed	District	Ward	Herd size	Breeding system	Grazing	Serology results
KP1	F	6yrs	Cross	Pangani	Kipumbwi	L	Natural	Communal	Positive
KP2	F	3yrs	Cross	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP3	F	9m	Local	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP4	M	11m	Local	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP5	F	2yrs	Cross	Pangani	Kipumbwi	S	Natural	Communal	Negative
KP6	F	5yrs	Local	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP7	F	2yrs	Local	Pangani	Kipumbwi	L	Natural	Communal	Positive
KP8	F	1yr	Cross	Pangani	Kipumbwi	L	Both	Communal	Negative
KP9	F	1.5yrs	Local	Pangani	Kipumbwi	M	Both	Communal	Negative
KP10	F	7yrs	Local	Pangani	Kipumbwi	M	Both	Communal	Negative
KP11	F	1yr	Local	Pangani	Kipumbwi	L	Natural	Communal	Positive
KP12	F	7m	Local	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP13	F	3yrs	Cross	Pangani	Kipumbwi	L	Natural	Communal	Positive
KP14	F	1yr	Cross	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP15	M	10m	Cross	Pangani	Kipumbwi	S	Natural	Communal	Negative
KP16	F	4.5yrs	Cross	Pangani	Kipumbwi	M	Natural	Communal	Negative
KP17	M	6m	Cross	Pangani	Kipumbwi	M	Natural	Communal	Negative
KP18	F	5yrs	Cross	Pangani	Kipumbwi	M	Natural	Communal	Negative
KP19	F	3yrs	Cross	Pangani	Kipumbwi	M	AI	Communal	Negative
KP20	M	6yrs	Cross	Pangani	Kipumbwi	S	Natural	Communal	Negative
KP21	M	7yrs	Cross	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP22	F	7yrs	Cross	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP23	F	5yrs	Cross	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP24	M	2yrs	Cross	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP25	F	5yrs	Local	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP26	F	4.5yrs	Local	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP27	F	7m	Local	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP28	F	3.5yrs	Cross	Pangani	Kipumbwi	M	Natural	Communal	Negative
KP29	M	1.5yrs	Local	Pangani	Kipumbwi	M	Natural	Communal	Negative
KP30	F	5yrs	Local	Pangani	Kipumbwi	M	Natural	Communal	Negative
KP31	F	3yrs	Cross	Pangani	Kipumbwi	L	Natural	Communal	Negative
KP32	M	11m	Local	Pangani	Kipumbwi	S	Natural	Communal	Negative
KP33	F	6yrs	Local	Pangani	Kipumbwi	M	Natural	Communal	Negative
KP34	F	8m	Local	Pangani	Kipumbwi	M	Natural	Communal	Negative
KP35	F	6yrs	Cross	Pangani	Kipumbwi	M	Natural	Communal	Negative
B001	M	9m	Cross	Pangani	Bweni	L	Natural	Communal	Negative
B002	F	5yrs	Cross	Pangani	Bweni	L	AI	Communal	Negative
B003	F	3yrs	Cross	Pangani	Bweni	L	AI	Communal	Positive
B004	F	8m	Cross	Pangani	Bweni	L	Both	Communal	Negative
B005	F	3yrs	Cross	Pangani	Bweni	L	Both	Communal	Negative
B006	F	2yrs	Cross	Pangani	Bweni	L	Both	Communal	Negative
B007	F	1.5yrs	Local	Pangani	Bweni	L	Natural	Communal	Negative
B008	F	6m	Local	Pangani	Bweni	L	Natural	Communal	Negative
B008	F	6yrs	Local	Pangani	Bweni	M	Natural	Zero	Negative

B010	F	2yrs	Local	Pangani	Bweni	M	Natural	Zero	Negative
B011	F	5yrs	Local	Pangani	Bweni	M	Natural	Communal	Negative
B012	F	7m	Cross	Pangani	Bweni	M	Natural	Communal	Negative
B013	F	10m	Cross	Pangani	Bweni	M	Natural	Communal	Negative
B014	F	5yrs	Cross	Pangani	Bweni	M	Natural	Communal	Negative
B015	F	7yrs	Cross	Pangani	Bweni	M	Natural	Communal	Negative
B016	F	7yrs	Local	Pangani	Bweni	S	Natural	Communal	Positive
B017	M	6Yrs	Local	Pangani	Bweni	S	Natural	Communal	Positive
BU51	F	5yrs	Cross	Pangani	Bushiri	S	Natural	Zero	Negative
BU52	M	4.5yrs	Cross	Pangani	Bushiri	L	Natural	Communal	Negative
BU53	F	5yrs	Local	Pangani	Bushiri	L	Natural	Communal	Positive
BU54	M	4yrs	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU55	F	6yrs	Local	Pangani	Bushiri	L	Natural	Communal	Positive
BU56	F	2yrs	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU57	M	2yrs	Local	Pangani	Bushiri	L	Natural	Communal	Positive
BU58	F	1yr	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU59	M	6m	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU60	M	11m	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU61	F	3yrs	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU62	M	7m	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU63	F	5yrs	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU64	F	1yr	Local	Pangani	Bushiri	L	Natural	Communal	Positive
BU65	F	11m	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU66	F	1yr	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU67	F	3.5yrs	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU68	F	2yrs	Local	Pangani	Bushiri	L	Natural	Communal	Positive
BU69	M	1yr	Local	Pangani	Bushiri	L	Natural	Communal	Negative
BU70	F	2yrs	Local	Pangani	Bushiri	L	Natural	Communal	Positive
TC001	F	5yrs	Cross	Tanga city	Central	M	AI	Zero	Negative
TC002	F	8m	Cross	Tanga city	Central	M	AI	Zero	Negative
TC003	F	2yrs	Cross	Tanga city	Central	M	Natural	Zero	Negative
TC004	F	4yrs	Cross	Tanga city	Central	M	Natural	Zero	Negative
TC005	F	3yrs	Cross	Tanga city	Central	M	Natural	Zero	Negative
TC006	F	11m	Cross	Tanga city	Central	M	Natural	Zero	Negative
TC007	F	6yrs	Cross	Tanga city	Central	S	AI	Zero	Negative
TC008	M	7m	Cross	Tanga city	Central	S	Natural	Zero	Negative
TC009	F	3yrs	Cross	Tanga city	Central	M	Natural	Zero	Negative
TC010	F	1yr	Cross	Tanga city	Central	M	Natural	Zero	Negative
TC011	F	1yr	Cross	Tanga city	Central	S	Natural	Zero	Negative
TC012	M	9m	Cross	Tanga city	Central	M	AI	Zero	Negative
TC013	F	6m	Cross	Tanga city	Central	M	AI	Zero	Negative
TC014	F	2yrs	Cross	Tanga city	Central	S	Natural	Zero	Negative
NM001	F	2yrs	Cross	Tanga city	Nguvumali	M	AI	Zero	Negative
NM002	M	1yr	Cross	Tanga city	Nguvumali	M	AI	Zero	Negative
NM003	F	1.5yr	Cross	Tanga city	Nguvumali	S	AI	Zero	Negative
NM004	F	3yrs	Cross	Tanga city	Nguvumali	S	Natural	Zero	Negative
NM005	F	11m	Cross	Tanga city	Nguvumali	M	Natural	Zero	Negative
NM006	F	2yrs	Cross	Tanga city	Nguvumali	M	AI	Zero	Negative
NM007	F	3yrs	Cross	Tanga city	Nguvumali	M	Natural	Zero	Negative
NM008	F	10m	Cross	Tanga city	Nguvumali	M	Natural	Zero	Negative
NM008	F	7yrs	Cross	Tanga city	Nguvumali	M	Both	Zero	Negative
NM010	F	6m	Cross	Tanga city	Nguvumali	S	Natural	Zero	Negative
NM011	F	9m	Cross	Tanga city	Nguvumali	M	Natural	Zero	Negative
NM012	F	5yrs	Cross	Tanga city	Nguvumali	M	Natural	Zero	Negative
NM013	F	5yrs	Cross	Tanga city	Nguvumali	M	Natural	Zero	Negative

NM014	F	7m	Cross	Tanga city	Nguvumali	M	Natural	Zero	Negative
NM015	F	11m	Cross	Tanga city	Nguvumali	M	Natural	Zero	Negative
NM016	F	6yrs	Cross	Tanga city	Nguvumali	M	Natural	Zero	Negative
M001	F	2yrs	Cross	Tanga city	Maweni	M	Natural	Zero	Negative
M002	F	3yrs	Cross	Tanga city	Maweni	M	Natural	Zero	Negative
M003	F	8yrs	Cross	Tanga city	Maweni	S	Natural	Zero	Negative
M004	F	2yrs	Cross	Tanga city	Maweni	S	Natural	Zero	Negative
M005	F	1.5yrs	Cross	Tanga city	Maweni	S	AI	Zero	Negative
M006	F	2yrs	Cross	Tanga city	Maweni	L	Natural	Zero	Negative
M007	F	8m	Cross	Tanga city	Maweni	L	Natural	Zero	Negative
M008	F	2yrs	Cross	Tanga city	Maweni	L	Natural	Zero	Negative
M009	F	5yrs	Cross	Tanga city	Maweni	M	Natural	Zero	Negative
M010	F	1yr	Cross	Tanga city	Maweni	M	Natural	Zero	Negative
M011	F	1yr	Cross	Tanga city	Maweni	M	Natural	Zero	Negative
M012	F	2yrs	Cross	Tanga city	Maweni	M	Natural	Zero	Negative
PV001	F	4.5yrs	Cross	Mkuranga	Vianzi	S	Natural	Zero	Negative
PV002	F	6yrs	Local	Mkuranga	Vianzi	L	AI	Communal	Negative
PV003	F	5yrs	Local	Mkuranga	Vianzi	L	AI	Communal	Negative
PV004	F	5yrs	Local	Mkuranga	Vianzi	L	AI	Communal	Negative
PV005	F	1yr	Cross	Mkuranga	Vianzi	L	AI	Communal	Negative
PV006	F	4yrs	Cross	Mkuranga	Vianzi	M	Natural	Communal	Negative
PV007	M	9m	Cross	Mkuranga	Vianzi	M	Natural	Communal	Negative
PV008	F	3yrs	Cross	Mkuranga	Vianzi	M	Natural	Communal	Negative
PV009	F	7yrs	Cross	Mkuranga	Vianzi	M	Natural	Communal	Negative
PV010	F	5yrs	Cross	Mkuranga	Vianzi	M	Natural	Communal	Negative
PV011	M	3yrs	Local	Mkuranga	Vianzi	M	Natural	Communal	Negative
PV012	F	5yrs	cross	Mkuranga	Vianzi	S	Natural	Zero	Negative
MK 001	F	6yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Positive
MK002	F	3yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
MK003	F	2yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
MK004	F	3yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
MK005	M	4.5yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
MK006	F	6m	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
MK007	F	5yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
MK008	F	7yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Positive
MK009	F	5yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
MK010	F	11m	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
MK011	M	2yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
MK012	F	5yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Positive
MK013	F	5yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Positive
MK014	F	6yrs	Local	Mkuranga	Mkuranga	L	Natural	Communal	Negative
TEN 001	F	5yrs	Cross	Mkuranga	Tengelea	L	AI	Communal	Negative
TEN 002	F	5yrs	Cross	Mkuranga	Tengelea	L	AI	Communal	Positive
TEN 003	F	4.5yrs	Cross	Mkuranga	Tengelea	L	AI	Communal	Positive
TEN 004	F	2yrs	Cross	Mkuranga	Tengelea	L	AI	Communal	Negative
TEN 005	F	6yrs	Cross	Mkuranga	Tengelea	S	Natural	Communal	Negative
TEN 006	F	8m	Cross	Mkuranga	Tengelea	S	Natural	Communal	Negative
TEN007	F	5yrs	Cross	Mkuranga	Tengelea	M	Natural	Communal	Negative
TEN008	F	5yrs	Cross	Mkuranga	Tengelea	M	Natural	Communal	Negative
TEN009	F	2yrs	Cross	Mkuranga	Tengelea	M	Natural	Communal	Negative
TEN010	F	5yrs	Cross	Mkuranga	Tengelea	M	Natural	Communal	Negative
TEN011	M	6m	Cross	Mkuranga	Tengelea	M	Natural	Communal	Negative
TEN012	F	1.5yrs	Cross	Mkuranga	Tengelea	M	Natural	Communal	Negative
TEN013	F	6yrs	Cross	Mkuranga	Tengelea	M	Natural	Communal	Negative

TEN014	F	2yrs	Cross	Mkuranga	Tengelea	M	Natural	Communal	Negative
KU001	F	7yrs	Local	Kisarawe	Kurui	L	Natural	Communal	positive
KU002	F	3yrs	Local	Kisarawe	Kurui	L	Natural	Communal	Negative
KU003	F	1yr	Local	Kisarawe	Kurui	L	Natural	Communal	positive
KU004	M	4.5yrs	Local	Kisarawe	Kurui	L	Natural	Communal	Negative
KU005	F	5yrs	Local	Kisarawe	Kurui	L	Natural	Communal	Negative
KU006	F	5yrs	Local	Kisarawe	Kurui	L	Natural	Communal	Negative
KU007	F	3yrs	Local	Kisarawe	Kurui	L	Natural	Communal	Negative
KU008	F	11m	Local	Kisarawe	Kurui	L	Natural	Communal	Negative
KU009	M	2yrs	Local	Kisarawe	Kurui	M	Natural	Communal	Negative
KU010	F	2yrs	Local	Kisarawe	Kurui	M	Natural	Communal	positive
KU011	F	7yrs	Local	Kisarawe	Kurui	M	Natural	Communal	Negative
KU012	F	5yrs	Local	Kisarawe	Kurui	M	Natural	Communal	positive
KU013	F	6yrs	Local	Kisarawe	Kurui	M	Natural	Communal	Negative
KU014	F	2yrs	Cross	Kisarawe	Kurui	M	Natural	Zero	Negative
KU015	F	4.5yrs	Cross	Kisarawe	Kurui	S	Natural	Communal	Negative
MS001	F	3yrs	Cross	Kisarawe	Msanga	S	Natural	Communal	Negative
MS002	M	1.5yrs	Cross	Kisarawe	Msanga	M	AI	Zero	Negative
MS003	F	4.5yrs	Cross	Kisarawe	Msanga	M	AI	Zero	Negative
MS004	F	5yrs	Cross	Kisarawe	Msanga	S	Natural	Communal	Negative
MS005	F	5yrs	Cross	Kisarawe	Msanga	S	Natural	Communal	Negative
MS006	M	11m	Local	Kisarawe	Msanga	M	Natural	Communal	Negative
MS007	F	6yrs	Local	Kisarawe	Msanga	M	Natural	Communal	Negative
MS008	F	2yrs	Local	Kisarawe	Msanga	M	Natural	Communal	Negative
MS009	M	5yrs	Local	Kisarawe	Msanga	M	Natural	Communal	Negative
MS010	M	7yrs	Local	Kisarawe	Msanga	L	Natural	Zero	Negative
MS011	F	6yrs	Cross	Kisarawe	Msanga	L	Natural	Zero	Negative
MS012	F	5yrs	Cross	Kisarawe	Msanga	L	Natural	Zero	positive
MS 013	F	7yrs	Cross	Kisarawe	Msanga	L	Natural	Zero	positive
MS 014	F	7yrs	Cross	Kisarawe	Msanga	L	Natural	Zero	Negative
MS 015	F	10m	Cross	Kisarawe	Msanga	L	Natural	Zero	Negative
KC-001	F	6yrs	Local	Kisarawe	Chole	L	Natural	Communal	positive
KC-002	F	2yrs	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-003	F	6yrs	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-004	F	7m	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-005	F	5yrs	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-006	F	7m	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-007	F	6yrs	Local	Kisarawe	Chole	L	Natural	Communal	positive
KC-008	M	4.5yrs	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-009	F	8m	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-010	F	3yrs	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-011	F	7yrs	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-012	M	1yr	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-013	F	6yrs	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-014	F	2yrs	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-015	F	3yrs	Local	Kisarawe	Chole	L	Natural	Communal	Negative
KC-016	M	11m	Local	Kisarawe	Chole	L	Natural	Communal	Negative

Herd size (L=Large, M=Medium, S= Small)

Sex (M=male, F =Female)

Age (yrs=Years, yr= year,m =month)

AI=Artificial insemination

**Appendix 2: Questionnaire**

Questionnaire serial number: -----

**Interviewer-Administered Questionnaire**

**Introduction and consent section:**

**Informed Consent**

My name is **Fredy Makoga** a master student from Sokoine University of Agriculture. I am conducting a study that asks questions about Lumpy Skin Disease around this area. This study is part of TVLA activities aiming at understanding the diseases situation for planning a proper control measure including vaccine development for improvement of livestock health. This study will take place in November 2022 to March 2023, I would appreciate your participation in this study. Whatever information you provide will be kept strictly confidentially and participation in this study is voluntary. However, your participation is vital for the success of this study.

Would you like to participate in this study? YES/NO

If YES continue

Start time..... End time.....

Region .....

District.....

Ward/ street.....

Interviewer Name.....

No	Questions	Responses	
<b>Section 1: Demographic and household characteristics of respondent</b>			
1	Name	ID No	
2	Respondent age	1. $\geq 18-24$ 2. 25-34 3. 35-44	4. 45-60 5. >60 6. I don't know
3	Gender	1. Male 2. Female	
4	What is your highest level of education?	1. Not attended school Primary 3. Secondary 4. Tertiary	5. Others mention
5	What is your role in the household?	1. Owner 2. Family member 3. Attendant	4. Others mention
6	What is your marital status?	1. Married 2. Single 3. Divorced	4. Others mention.....
7	What is your employment status?	1. Formal employment 2. Unemployed 3. Retired	5. Others
8	What is your main source of income?	1. Livestock keeping 2. Crop farming 3. Employment 4. Business	5. Mixed sources 6. Others mention
9	For how long you have been involved in livestock farming?	A. 1 - 10years B. 10- 20 years	C. Lifetime activity

<b>Section 2: Knowledge of communities on LSD</b>			
10	Have you heard of Lumpy skin disease?	1. Yes 2. No	
11	Do you know any of the LSD sign?	1. Yes	0. No
12	What are the signs of LSD you know?	1. Skin lesions 2. mortalities 3. milk drop	4. Abortion 5. I don't know
13	Do you know loss/losses associated to LSD?	1. Yes	2. No
14	Losses associated with LSD is due to?	1. Drop in milk production 2. Mortalities 3. Increased veterinary cost 4. Abortion 5. Damage to hide	6. Others, mention.....
15	Are you aware of the transmission route of LSD?	1. Yes	2. No
16	How is LSD transmitted?	1. Contact with infected animals 2. Blood feeding arthropods	3. Through semen during bleeding 4. I don't know
17	Have you ever experienced LSD in your herd?	1. Yes 2. No	
18	If yes, when did it appeared?	1. Within the past 6 month 2. 1 year ago 3. 2 years ago	4. More than 2 years ago

19	Which group of animals were affected?	<ol style="list-style-type: none"> <li>1. Only young animals</li> <li>2. Only old animals</li> <li>3. No specific age group</li> </ol>	4. Others mention.....
20	In which season animals are affected by the condition?	<ol style="list-style-type: none"> <li>1. Rain season</li> <li>2. Dry season</li> <li>3. No specific season</li> </ol>	<ol style="list-style-type: none"> <li>4. Others mention.....</li> <li>5. I don't know.</li> </ol>
21	Do you know any LSD control measure?		<ol style="list-style-type: none"> <li>1. No</li> <li>Y</li> </ol>
22	If YES, how is the disease controlled	<ol style="list-style-type: none"> <li>1. Vaccination</li> <li>2. Proper use of acaricide</li> </ol>	<ol style="list-style-type: none"> <li>3. Avoiding contact and Restricting animal movement</li> <li>4. I don't know</li> </ol>
23	Do you know any blood feeding arthropod?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>	
24	If yes in above question, what are they?	<ol style="list-style-type: none"> <li>1. ....</li> <li>2. ....</li> <li>3. ....</li> </ol>	<ol style="list-style-type: none"> <li>4. ....</li> <li>5. ....</li> <li>6. ....</li> </ol>
25	How do you control them?	<ol style="list-style-type: none"> <li>1. Use of acaricides</li> <li>2. Bush clearing</li> <li>3. Use of natural herbs</li> </ol>	<ol style="list-style-type: none"> <li>4. Others</li> <li>5. I don't know</li> </ol>

**Section 3: Respondents attitude toward LSD**

Tick the appropriate number (1= Agree, 0= Disagree, 2= Neutral/ I don't know) ( )

	Statement	Response		
		1	0	2
26	Lumpy Skin disease is a hazardous disease of economic importance			
27	Cattle are at high risk of being infected with LSD virus in this district			
28	Spread of LSDV virus infection to animals can be prevented			
29	Vaccinating animals against LSD is important.			
30	Available vaccine works against LSD.			
31	Communal grazing and watering ponds can facilitate the transmission of LSDV.			
32	Bloody feeding arthropods are responsible for the transmission of LSD			
33	Proper use of acaricide helps to control LSD			
34	Animal movement contributes to the spread of the disease.			
35	All breeds are equally susceptible to LSD.			
36	Vaccines against LSDV are readily available			
37	Vaccines against LSDV are affordable			

**Section 4: Respondents practices on LSD transmission and prevention**

	Statement	Responses		
38	What is your herd size	1.Small	2.Medium	3.Large
39	How do you apply acaricide?	1.Home spraying	2.Communal dipping points	
40	Do you have history of introducing new animals in your herd?	1.Yes	2.No	
41	Grazing system?	1.zero grazing	2.Communal grazing	
42	Watering system	1.Piped water at home	2.Communal watering points	
43	Animal breeding?	1.AI	2.Naturally	3.Both
44	Source of breeding bull	1.Own	2.Shared	
45	Source of replacement stalk?	1.Own	2.Purchased	3. Both
46	How do you deal with LSD sick animals?	1.Treat	2.Leave alone	
47	Vaccination against LSD?	1.Yes	2.No	
48	What type of animals are you dealing with?	1.Dairy	2.Beef	3.Dual purpose
49	Which breed do you keep?	1.Exotic	2.Indigenous	3.Cross breed

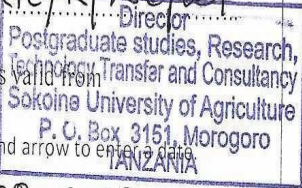
**THANK YOU FOR YOUR PARTICIPATION**

**Appendix 3: Statement of Research Ethical Approval**

SECTION P: FOR OFFICIAL USE

(i) APPROVAL

<p>Date received : Click here and arrow to enter a date.</p> <p>27/08/2023</p>	<p>Received by: Click here to type names.</p> <p>MARTHA E. MASHI</p>
<p>Date of approval: Click here and arrow to enter a date.</p> <p>.....</p> <p>Name: <b>ESRON D. KARIMURIBO</b></p> <p>Title: <b>DIRECTOR.</b></p> <p>Approving authority in capital letters (example: SRPC. Departmental /College/Centre R&amp;PC</p> <p>Click here to enter the name of approving authority.</p>	<p>Approval reference number: Click here to enter number.</p> <p>SUA/DPRTC/R/186/031</p> <p>Approval is valid from</p> <p>Click here and arrow to enter a date.</p> <p>30.08.2023.</p> <p>To: Click here to enter a date.</p> <p>.....</p>
<p>*All undergraduate studies shall be evaluated and/or approved by the College/Centre R&amp;PC and Reports submitted to the chair Research Ethica Committee, DPRTC</p>	
<p>(ii) NOT APPROVED</p> <p><input type="checkbox"/> The applicant is required to revise the application by addressing reviewer's concerns (Reviwer's comments are provided to the applicant)</p> <p><input type="checkbox"/> Other reasons (Describe briefly)</p>	



## Appendix 4: Plagiarism report

MAKOGA\_FREDY DISSERTATION\_final2.docx

### ORIGINALITY REPORT

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SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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### **Kuhusu Tasnifu Hii**

Utafiti huu ulifanyika kwa lengo la kupata taarifa muhimu kuhusu ugonjwa wa mapelengozi ikiwemo kubaini kiwango cha maambukizi, vichocheo vya maambukizi pamoja na uelewa na mtazamo wa jamii, dhidi ya ugonjwa huu hatari kwa sekta ya mifugo na usalama wa chakula nchini na duniani kote. Matokeo ya utafiti yalibaini kiwango cha maambukizi ya ugonjwa wa mapelengozi cha 13.5% ya wanyama waliopimwa na 22.73% ya kaya zote ambazo wanyama walipimwa. Matokeo pia yalibaini vichocheo vya maambukizi pamoja na kubaini kiwango kidogo cha uelewa kuhusu ugonjwa huu. Matokeo yalionesha kundi kubwa la wafugaji likiamini chanjo dhidi ya mapelengo kwa ng'ombe kuwa na umuhimu ingawa wengi walikili kuwa chanjo hiyo haipatikani kiuraisi na pia inauzwa kwa bei kubwa. Matokeo ya utafiti huu ni muhimu katika kupanga na kuchukua hatua mbalimbali za kudhibiditi ugonjwa huu ikiwa ni Pamoja na kufanya tafiti zaidi zitakazopelekea kupatikana kwa chanjo ili kuboresha afya ya mifugo nchini.