Estimating Economic Burden and Factors Perceived to Be Associated With Lumpy Skin Disease in Cattle in Namisindwa District, Eastern Uganda

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Research article

Keywords: Notifiable disease, Transboundary Animal disease, Epidemiology, Animal Health Economics, Cattle, Uganda

Posted Date: December 4th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-30528/v1>

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Abstract

Background

Globally, livestock contributes about 40% of agricultural output sustaining livelihoods and food security of almost a billion people. In Uganda, livestock contributes 5.2% and 12.7% to the total national GDP and agricultural GDP, respectively. In districts like Namisindwa, diseases like Lumpy Skin Disease (LSD) affect the sector undermining its trade and production. Studies on the economic impact and risk factors have not been undertaken in such areas. This study thus sought to unravel information regarding economic impact and perceived risk factors associated with LSD in Namisindwa district. A cross sectional study involving quantitative approaches was employed in this study. Dependent variables were period prevalence and associated economic losses due effect of LSD on cattle herds while independent variable were potential factors influencing spread of the disease among cattle herds. The financial impact assessment was based on the farmers' calendar year.

Results

The total economic losses incurred by farmers in Namisindwa district in a single outbreak of LSD was estimated at UGX 574,999,741 (USD 155,405). The most prominent economic loss due to LSD was attributed to low milk yield in lactating cattle as well as poor draught power performance. Other major contributions to economic losses due to LSD after the aforementioned two factors were cost of veterinary services and mortalities of cattle. Economic losses associated with loss of calves, and skin losses were perceived to be the lowest. Introduction of new animals, communal grazing and access to veterinary services were significantly associated with outbreaks of Lumpy Skin Disease. Specifically, farmers with access to veterinary services were less likely to be affected with the rampant spread of the LSD in their cattle, $OR = .03361$ and $P\text{-value} < .05$.

Conclusion

There is need for Ministry of Agriculture, Animal Industry and Fisheries in Uganda to advance interventions for prevention and control of LSD in the district. Larger scale and rigorous studies ought to be undertaken also to understand the risk factors and economic impact of LSD outbreaks.

Background

Globally, livestock contributes about 40% of agricultural output sustaining livelihoods and food security of almost a billion people in the world[1]. In Sub-Saharan Africa, the livestock sector accounts for about 30% of the agricultural GDP and almost 60% of the value of edible livestock product is generated by cattle[2]. Livestock provide a safety net to resource poor farmers and traders along the value chain throughout the developing world[3]. In Uganda, livestock production is one of the major economic activities which contribute 5.2% and 12.7% to the total national GDP and agricultural GDP, respectively [4]. Furthermore, livestock provide a potential pathway out of poverty for rural producers and other actors

along the marketing chain where market access exists, constitute a means of investment and perform important networking functions[5]. Namisindwa district among other districts in Uganda, livestock sector accounts for a significant contribution to the districts' revenue, income to the poorest households and a major source of fertilizer in coffee-banana plantations[6]. Despite the huge economic importance of livestock to households and to nations[7], the sector is faced with numerous challenges including diseases [8]. One such disease is LSD with one of its endemic hotspots being eastern Uganda [9].

LSD is viral disease of cattle caused by a virus of the family Poxviridae, also known as *Neethling virus*[10]. It is characterized by fever, enlarged lymph nodes, firm and circumscribed nodules in the skin, and ulcerative lesions particularly of the mucous membrane of the mouth[11]. It is a notifiable disease in Uganda[12].

LSD is one of the epizootic diseases of cattle associated with mortality and morbidity thus economic losses to livestock farmers[13][14]. Many studies have recognized LSD one of the major Trans-boundary Animal Diseases (TADs) limiting livestock production in a wide range of agro-climatic zones[15][16][17].

Also, LSD disrupts livestock trade and related products locally and internationally[18]. For instance, in Turkey where about \$241.903.500 US dollars was lost during a two year outbreak of LSD[19]. It is a growing and serious problem in developing countries like Uganda, where capacity to cope with the cost and logistics of controlling the disease is quite limited[20]. The disease is spread widely in all regions in Uganda[9]. Namisindwa district located in Eastern Uganda (considered as a hotspot of the disease) is no exception. The District Veterinary Officer, surveillance reports of 2017 reveal Lumpy Skin Disease as one of the diseases affecting livestock production in the district. However, information on the impacts and risk factors associated with LSD outbreaks are not well documented. This study therefore sought to document the economic impacts of lumpy skin disease and perceived associated risk factors for the occurrence of the disease.

LSD threatens household nutrition and incomes due to its morbidity, mortality and has significant socioeconomic impact nationally[21]. The apparent morbidity and mortality rates of LSD were approximated at 9.11% and 0.51%, respectively in Iraq[16]. Its occurrence in livestock industry results into milk yield loss, infertility, skin and hide loss, abortion and death[18]. Decrease in animal body weight due to LSD can be up to 80% [11]. In Uganda, the disease has severely affected livestock sector in many districts including Namisindwa[9]. Despite its devastating effects, less has been done to address the effects associated with LSD in Namisindwa. Namisindwa district has high human population explosion[22], dynamic economic activities[23] and climate[24]. This is partly because less is known about the risk factors associated with Lumpy Skin Disease occurrence and its impact on farmers' income and livelihood in the district. This study therefore sought to unravel information regarding perceived factors associated with occurrence of LSD and the economic impact of the disease in Namisindwa district.

Methods

Description of the study area

The study was conducted in Namisindwa district, Bugisu region, eastern Uganda [25]. Namisindwa District is bordered by Bududa District to the North, Kenya to the East and South, Tororo District to the South-west, and Manafwa District to the West[26]. The district headquarters at Namisindwa are located at Bupoto approximately 40 kilometers (25 mi), by road, South-east of Mbale. Namisindwa district GPS coordinates are 00°49'N 34°23'E, having a population of people approximately 178,746[26]. Generally, 97 percent of the human population live in rural areas while only about 3 percent in are urban dwellers within the district [26]. The districts experience bimodal type of rainfall with the highest in the first season of March to June and second season which is normally light in August to November[27]. A short dry spell is between June to July while December to March spell is longer[27]. In general, there are no extreme temperature ranges; this condition is attributed to close proximity to Mt. Elgon National Forest park [24]. Agriculture is the major economic activity in the district as majority of farmers are small holders who grow both perennial (e.g. coffee among others), annual crops (e.g. bananas, onions, maize, Irish, etc.) and rear livestock (e.g. cattle, goats, sheep, poultry, pig etc.). Livestock production systems are both extensive and semi intensive and most breeds kept are cross breeds[28].

Study population

The study population included cattle farming households and their respective cattle herds. A household was a group of people living together and cattle herd is a group of cattle of the same farm owned by the household(s).

Study design

A cross sectional design involving quantitative approaches was employed in this study. Dependent variables were period prevalence and associated economic losses due effect of LSD on cattle herds while independent variable were potential factors influencing spread of the disease among cattle herds. The financial impact assessment was based on the farmers' calendar year which involve four seasons: beginning of dry season, (November and December), end of dry season, (January and February), beginning of rainy season, (March, April and May), end of rainy season, (July, August, September, and October). This was from December 2017 to December 2018.

Sample size determination

The sample size was estimated using Cochran formal [29] for sample size determination as shown below;

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

Where: n, was required sample size; Z was the critical Z-score at 95% confidence level; p was the expected prevalence of LSD in Namisindwa; d was desired absolute precision. Assuming 32% of cattle herds (p=0.32) in Namisindwa district suffered LSD in the last one year[9], at 95% level of confidence (Z=1.96) and 5% level of precision (d=0.05), the sample size(n) was;

$$n = \frac{1.96^2 \times 0.32 \times (1-0.32)}{0.05^2}$$

$$n = 334.4 \approx 336$$

Sampling strategy

A multistage sampling was carried out at Sub County and Parish levels. Nine (9) Sub counties were selected randomly from the 18 sub counties in the district these include: Namabya, Bubutu, Bukhabusi, Mukoto, Bukiabi, Lwakhakha, Bumbo, Namboko and Bukhaweka. Three parishes were selected from each sub county randomly. At parish level, participating households were selected by systematic random sampling from list of households having cattle herds generated with the help of sub county veterinary extension worker.

Data collection

A semi-structured questionnaire was developed (Additional file 1), pre-tested and administered to respondents (selected household heads). It captured data mainly on location, household size, education, religion, knowledge of LSD, cattle farming systems, herd size and structure, draught power, whether herd suffered from LSD in 2017/2018, number of cows that aborted due to LSD, number of cattle that died from LSD, average milk produced by cows, price of milk, price of cattle, vaccination against LSD, cost of treatment or vaccination in controlling LSD.

Economic impact of lumpy skin disease

This was done by quantifying the secondary variables and fitting them in a relevant model.

Economic loss = cost of mortality of infected cattle + cost of morbidity + cost of veterinary intervention.

Where;

1) Mortality

- Mortality of cattle occur due to starvation and dehydration as a result of painful swellings in the oropharynx, intestines and secondary bacterial infection,

2) Morbidity

- Permanent damage to skin due to nodular inflammatory swellings that become necrotic and sloughs off leaving raw painful wound.
- Loss of draught power due to general body weakness and lesions in that restricts movement
- Loss of beef result from emaciation/cachexia/wasting occur due to interference in feeding
- Loss of milk production also results from anorexia
- Abortions occur due to fever and intrauterine infection
- Painful lesions on sheath of bulls and debility in females interferes with reproduction

3) Cost of veterinary intervention

- In control of LSD through treatment of infected animals and vaccination with vaccine to minimize impact

Perceived risk factors associate with lumpy skin disease

The perceived risk factors were identified through assessment of the relationship (multivariate logistic regression) between the disease status of the herds and household and herd level characteristics. Inferences were based on odds ratio, chi-square and p-value.

Data management and analysis

Economic impact of lumpy skin disease

Data from household survey questionnaires was coded, cleaned and entered into Microsoft Excel spreadsheet 2010. This data was imported to STATA software (version 13) [30] for analysis. Chi-square test was used to compute the probability value(p-value) and significance differences[31].

Economic impacts resulting from lumpy skin disease occurrence in the study area was determined through financial costs and losses in Uganda Shillings and US dollar. This was calculated based on livestock respondents' perceptions. A model that was used in this study was adopted from[18] and [32] to estimate costs of lumpy skin disease in form of morbidity(milk, abortions, draught power and hide), mortality and control expenditures. The mathematical model considered direct costs associated with lumpy skin disease only.

$$TL = A+B+C: \dots\dots\dots(1)$$

Where

TL=Total loss associated with the disease.

A= Loss associated with mortality, and B= Losses associated with morbidity, C= Costs of veterinary intervention.

Estimation of Mortality (A)

- Mortality of cattle occur due to starvation and dehydration as a result of painful swellings (in the oropharynx and intestines), and secondary bacterial infection.
- Economic value of cattle that die of LSD during the period of outbreak can be computed from the formula:

Cost of mortality of infected cattle (Value of cattle that die)

= (Population at risk X Mortality risk) X average price of cattle

Where Population at risk = number of cattle in the whole district (affected district)

$$\text{and Mortality risk} = \left(\frac{\text{number of cattle dying of LSD}}{\text{Number of cattle disease with LSD}} \right) \times 100 \dots \dots \dots i$$

Estimation of morbidity

(i) Skin losses due to LSD

Loss of skin= Number of infected cattle that did not die X Average price of skin.....(i)

(ii) Milk losses due to LSD

Milk loss due to abortion= Volume of milk lost due to abortion X price of milk.

Where,

Volume of milk lost due to abortion= number of cows that aborted X Duration of milking X daily milk yield.

Where,

Number of cows that aborted =Number of infected cows X Abortion risk

Where,

Number of infected cows =Number of infected cattle X average proportion cows in herds

Value of milk lost among non-aborted infected cows due to LSD =volume of milk lost among non-aborted infected cows X average price of milk.

Where,

Volume of milk lost among non-aborted infected cows = number of infected cows that did not abort X Daily milk yield X Percentage reduction in milk yield due to LSD.

Where,

Number of infected cows that did not abort = Number of infected cows X (1-abortion risk)

Therefore,

Total value of milk lost due to LSD in the cattle population = Value of milk lost due to abortion +Value of milk lost among non-aborted infected cows due to LSD.....(ii)

(iii) Cost of veterinary intervention

Value of treatment of infected cattle = Number of cattle infected X treatment cost per cattle.....(iii)

Vaccination

Value of vaccination of cattle in the district = Population of cattle at risk of LSD in the district X unit cost of vaccination.....(iv)

(iv) Draught power losses

Draft losses = total number of affected cattle X proportion of oxen in the herd X Unit cost of ploughing an acre of land X proportion of days spent without ploughing.....(v)

Perceived risk factors associated with Lumpy Skin Disease

Data from household survey questionnaires was coded and entered into spread sheet using Microsoft Excel spread sheet 2010. This data was imported to STATA software (version 13) [30] for analysis.

Results

Socio-demographic characteristics of respondents

The sampled households were inhabitants of nine sub counties in Namisindwa district (Table 1). Majority of the respondents were male 80.7% ($n = 271$), while the rest were female. Going by religion, Catholics had the biggest proportion 38.4% ($n = 129$); followed by Anglicans at 35.1% ($n = 118$); Muslims at 15.8% ($n = 53$) and least were Seventh Day Adventists (Table 1). Considering education level, respondents had attained mainly primary education 47.0% ($n = 158$) while a few of them had attained tertiary level education 8.7% ($n=29$) (Table 1).The major sources of income of the respondents were mixed farming 27.4% ($n = 92$) involving livestock and crop production.

Mortality and morbidity rates according to age, sex and breed of cattle

In terms of sex of the animals, male cattle were at more risk compared to their female counterparts (Table .2). Similarly, cross bred cattle and cattle at old age were more at risk compared to their respective counter parts. In terms of morbidity, the groups that were affected most were females (70.3%), old (41%) and cross bred (42.0%) cattle.

The following computations were made based on data obtained from primary sources

1. Average price of hide UGX 15,455.357
2. Average price of a newly born calf UGX 192,514.9
3. Number of aborted calves were23
4. Number of aborted cows were 23
5. Average quantity of milk yield per cow 5.5 Liters
6. Average price per litre of milk was UGX 1019.4
7. Number of lactating infected cows were 76
8. Average cost of treatment of LSD infected cattle UGX 110,979.3
9. Average cost of vaccination UGX 2000
10. Number of infected oxen’s 52
11. Average days spent without ploughing 26
12. Unit cost of ploughing an acre UGX 119,861.7

Economic impact of Lumpy Skin Disease in Namisindwa district

The total economic losses incurred by farmers in a single outbreak of LSD are estimated at UGX 574,999,741approximating to USD 155,406 in only investigated sub counties of Namisindwa district. The most prominent economic loss due to LSD is attributed to low milk yield in lactating cattle as well as poor drought power performance. Next major contributions to economic losses due to LSD after the aforementioned two factors are cost of veterinary services and mortalities of cattle. Economic losses associated with loss of calves, and skin losses were perceived to be the lowest (Figure 2).

Economic loss due to mortality of cattle as a result of LSD

Economic loss due to mortality of cattle as a result of LSD

= Number of cattle infected with LSD X Mortality risk X Average price of cattle
(I)

Where Mortality risk (%) = [(Number of cattle dying of LSD)/(Number of LSD infected cattle)]X100
(II)

Where, number of cattle dying of LSD = 39, number of cattle diseased with LSD = 199

Therefore, from equation (II) Mortality risk (%) = $(39/199) \times 100 = 20\%$

From equation (I), economic loss due to mortality of cattle as a result of LSD = $199 \times 0.2 \times 1,290,386.90 \text{UGX}$

Economic loss due to mortality of cattle as a result of LSD = **UGX 51,357,398.62**

4.4.2 Economic losses due to morbidity

Economic loss due to morbidity = (value of skin lost due to LSD+ value of calves lost due to abortion + value of milk lost due to LSD).

- **Value of skin lost due to LSD** = Number of infected cattle that did not die X average price of skin
.....(III)

Where, Number of infected cattle that did not die = total number of infected cattle (n=199) minus total number of infected which died (n= 39) = $(199-39 = 160)$; and average price of skin = UGX. 15,455.357

Therefore, from equation (III), Value of skin lost due to LSD = $160 \times 15,455.357$

Value of skin loss = **UGX 2,472,857.143**

- **Value of calves lost due to abortion**= number of calves lost due to abortion caused by LSD X Price of a calf

Where, number of calves lost due to abortion caused by LSD = 23 and price of a calf at birth was (192514.9 ± 65210.34)

Therefore, value of calves lost due to abortion= $23 \times 192,514.9$

Since an animal produces at an average of once in a year,

Value of calves lost in abortion due to LSD= **UGX4, 427,842.7**

- **Value of milk lost due to LSD in lactating cattle**

= Value of milk lost due to abortion+ Value of milk lost among non-aborted infected cows due to LSD

Where, value of milk lost due to abortion = Number of animals that aborted X average quantities of milk produced per cow X price of each liter of milk.....(IV)

Where, number of animals that aborted= 23 , average quantities of milk produced per cow = 5.5 ± 3.1 liters and price of each liter of milk = $\text{UGX}1019.4 \pm 124.6$

Therefore, value of milk lost due to abortion = $23 \times 5.5 \times 1019.4 = \text{UGX } 128,954.1/\text{per day}$

Value of milk lost among non-aborted infected cows due to LSD= number of lactating infected cows X average quantities of milk produced per cow X average price of each liter of milk.....(V)

Where, number of lactating infected cows=76, average quantities of milk produced per cow per day= 5.5 ± 3.1 liters, average price of each liter of milk = $\text{UGX}1019.4 \pm 124.6$

Therefore, Value of milk lost among non-aborted infected cows due to LSD= $76 \times 5.5 \times 1019.4$
=UGX 426, 109.2 per day

Therefore, from equations (IV) and (V), total value of milk lost due to LSD in lactating cattle = $128,954.1 + 426, 109.2$

=UGX 555, 063.3 per day

Therefore, on average 210 days of lactating, total value of losses associated with milk lost due to LSD = $555, 063.3 \times 210$

=UGX 116,563,293 per lactating period

- **Cost of veterinary intervention**

Cost of veterinary intervention= cost of treatment of infected cattle+cost of vaccination of cattle

Where, cost of treatment= Number of cattle infected X Average treatment cost per cattle.....(VI)

Number of cattle infected=190, average treatment cost per cattle= $\text{UGX } 110979.3 \pm 124227.8$

Cost of treatment = $190 \times 110979.3 = \text{UGX } 21,086,067$

- **Cost of vaccination of cattle against LSD**

= Population of cattle at risk of LSD X Unit cost of vaccination

Where, population of cattle at risk of LSD in the district in the year 2017=25,000 and Unit cost of vaccination= $\text{UGX } 2,000$

Cost of vaccination of cattle against LSD= $25,000 \times 2000$

=UGX 50, 000,000

Therefore, total cost of veterinary intervention= $21, 086, 067 + 50, 000,000$

= UGX 71, 086,067 annually

(IV) Draught power

= Total number of affected oxen X Average number of days spent without ploughing X Unit cost of ploughing an acre in a planting season

Where, total number of affected oxen= 52, Average number of days spent without ploughing= 26.4 ± 17.1 and Unit cost of ploughing an acre in a planting season = UGX 119,861.7 ± 207400.2

Therefore, total value lost to draught power = $52 \times 26.4 \times 119,861.7$

=UGX 164, 546, 141.8per planting season

In a year, there are two seasons, therefore, annual costs due to draught power losses = $164, 546, 141.8 \times 2$

=UGX 329,092,283.5

NOTE:

1. Off take rate of beef was not considered in this study because farmers would not recall or estimate exact beef loss during the time of the outbreak.
2. Reproductive rate was difficult to determine because it has long term morbidity and farmers cull animals that recover to guard against reoccurrence and transmission of the disease.
3. Indirect losses or costs such as restricted trade and cattle movement was not considered in this study

Risk factors contributing to the occurrence and transmission of Lumpy Skin Disease in Namisindwa district

Households that frequently introduced new cattle in their herd [Odd ratio (3.9)] were 3 times more likely to have cases of LSD in their farms than those that maintained old herd, cattle from households that share common grazing places (e.g. play grounds, water points, and market grounds) [Odd ratio (OR) 10] were 10 times more likely to contract LSD than those in households practicing zero grazing system. Farmers with access to veterinary services were less likely to have cases of the LSD in their farms [Odd ratio (OR) 0.3] than those that never accessed veterinary services or do self-medication. Cattle on farms that never controlled ectoparasites were at a high risk of contracting Lumpy Skin Disease [Odd ratio (OR) 20.0] 20 times than those on farms that practiced control of ectoparasites through routine application of Acaricide on their cattle.

Regarding months when LSD outbreaks are common, respondents noted the months of July, August and September to be associated with peak periods of LSD (Figure 3).

Discussion

Firstly, this study reports economic losses associated with mortality and morbidity of cattle due to LSD, and secondly the risk factors associated with LSD. Other authors previously noted that morbidity due to LSD leads to low carcass weight[33], increases treatment costs [34], and decreases quality of animal products such as milk, skin and beef[14]. More so affected oxen has reduced draught power which affects productivity at household level [34]. Based on computation of data obtained from farmers in this study, it was estimated that a single outbreak of Lumpy Skin Disease in Namisindwa amounts to USD 155,405.335. The reported economic loss was found to originate from mortality of adult cattle and abortions, loss of milk production in sick and aborted animals, cost of veterinary services, poor performance of traction oxen, and low quality of hides from the affected cattle. Besides, administration of antibiotics treatment in lactating animals results into drug residues in milk making it unfit for human consumption [35]. Importantly, indirect losses from restriction of cattle movements and trade also contribute to the economic losses; however, this was not estimated due to the limited scope of the study and inadequacy of data on revenue collected within the study area. Investigation of these indirect losses required data from cattle traders and commercial officer.

Investigation of potential risk factors influencing the occurrence and transmission of LSD was conducted. Factors analyzed were cattle breed, control of ectoparasites, grazing system, and regular introduction of new animals into the herd. With respect to cattle breed it was found that exotic breeds were more likely to be suffering from the disease than the indigenous breeds. Higher prevalence of LSD could be explained by low resistance of the exotic cattle breed to an endemic infection. It was also found that lack of ectoparasites control, communal grazing, and introduction of new animals were significant factors associated with LSD outbreaks. The role of ectoparasites in the transmission of LSD is well known; therefore, it was not surprising that farms that were not controlling ectoparasites like ticks and biting flies, registered high rates of infections compared those farms which practiced ectoparasites control.

Communal grazing was listed to contribute to LSD outbreaks in other studies in Ethiopia[36]. During communal grazing direct such as through grooming and mating; and indirect contacts such as contact with saliva of infected on pasture and biting flies would aid transmission of Lumpy Skin Disease between infected and 'clean' herds. Additional to that farmer's in Namisindwa practices bulls fights as a creational activity and show of pride of owning the biggest and furious bull which gather many sub counties both within and out the district which increases the risk of LSD spread compared to those who purely do dairy farming

Furthermore, farms that regularly introduce new cattle were more likely to have LSD Introduction of new animals into a herd without following proper quarantine procedure is one of the means by which diseases

are transmitted between farms.

It is likely that cattle that were sold originated from infected herd and the owners of such farms usually tend to sell off their animals before they go down with the disease thereby transmitting the disease to 'clean' farms. This is common among illegal traders who cross the borders between Kenya and Uganda. This result thus provides an avenue for design of epidemiological interventions to address LSD. Animal trading has been shown in some studies to contribute to spread and transmission of LSD similarly to the results in this current study[14][37]. Respondents pointed to introduction of new animals from cattle market as one of the factors contributing to LSD transmission to cattle originally on the farm. Ectoparasites mentioned by respondents to contribute to LSD in this study relates with the epidemiology of LSD [16]. This indicates the knowledge among communities regarding LSD thus can inform design of control interventions.

Conclusions

- The economic losses associated with LSD single outbreak in the investigated sub counties were due to mortality and morbidity amounting to UGX 574,999,741 (USD 155,406) in Namisindwa district.
- Besides, information on the risk factors for the occurrence and transmission of Lumpy Skin Disease were gathered from farmers and indicates that introduction of new cattle, communal grazing and ectoparasites were the major drivers of LSD spread and transmission in the district.
- MAAIF and Namisindwa District Local Government should take interest and implement effective containment of the disease using available means.
- To guarantee the success and sustainability of the control program, constant involvement and participation of the affected community should be greatly encouraged.
- A country wide study directed at establishing total economic losses, the national incidence, geographical and spatiotemporal distribution of LSD should be conducted.
- Indigenous knowledge and methods of LSD control should be obtained from farmers in the disease endemic area, scrutinized and integrated into the national control program of the LSD.

Abbreviations

LSD	Lumpy Skin Disease
UGX	Uganda Shillings
USD	United States Dollar
OR	Odds Ratio
GDP	Growth Domestic Product
TADs	Trans-boundary Animal Diseases
UBOS	Uganda Bureau of Statistics
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries

Declarations

Ethical approval and consent to participate

Approval for this study was obtained from Namisindwa District Local Government (Number: CRNAMD 2010/13). Written and informed consent was obtained from the interviewed cattle owners and extension service providers to participate in the study.

Consent for Publication

Written and informed consent was obtained from Namisindwa District Local Government, cattle owners and extension service providers about publication of the findings from this study.

Availability of data and material

Data is available upon request

Competing interests

We declare no competing interests in this study.

Funding

This study was privately funded by the corresponding author.

Authors' contributions

Author	Contribution
IO	Designed the study, mobilized funds for the study and produced the first draft of the manuscript
SO	Supervised the study and assisted in writing the manuscript
AS	Assisted in data analysis and reviewing the manuscript
FE	Supervised the study and assisted in writing the manuscript

All authors read and approved the manuscript

Acknowledgements

We acknowledge support from Makerere University College of Veterinary Medicine for assisting in approval process of the study. We also thank the leadership and community members of Namisindwa District for the support during data collection.

Environmental Considerations

All equipments, tools and materials used during the study period was disposed in accordance with the recommendations of the National Environment Management Authority.

Limitation to the study

The following were the imitations that hindered the study process;

1. Language barrier
2. Collection of reliable data
3. Limited resources
4. Demand for money by the respondents.

Mitigation measures

The above limitations were solved by;

1. Hiring of a native to interpret for me within the district
2. Explaining the importance of the study to the people and its benefit to the animal population
3. Outsourcing and lobbying for help from the District and other interested persons in the study
4. Explaining the importance of the study to the area leaders; carry along a consent letter from the district to accept me carry out a student study.

Gender Consideration

The study was undertaken while recognizing gender norms within the target population.

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Tables

Table 1: Socio-economic characteristics of the respondents

Socio-demographic characteristics (n=336)	Freq.	Percent
SubCounty		
Bubutu	44	13.1
Bukhabusi	38	11.3
Bukhaweka	35	10.4
Bukiabi	39	11.6
Bumbo	39	11.6
Lwakhakha	33	9.8
Mukoto	38	11.3
Namabya	30	8.9
Namboko	40	11.9
Gender		
Male	271	80.7
Female	65	19.4
Religion		
Anglican	118	35.1
Catholic	129	38.3
Muslim	53	15.4
SDA	30	8.9
Others	6	1.8
Education level		
None	69	20.5
Primary	158	47.0
Secondary	80	23.8
Tertiary	29	8.7

Major source of income		
Crop farming	50	14.8
Mixed farming	158	47.02
Livestock farming	92	27.3
Business person	21	6.2
Formal job	15	4.5

Table 2: Mortality and case fatality rates according to age, sex and breed of cattle

	Number at risk	Number affected	Number of death	Morbidity rate (%)	Mortality rate (%)	Case fatality (%)
Sex						
Female	108	76	23	70.3	21.3	55.0
Male	228	123	16	54.4	7.0	7.0
Age						
Old	325	134	37	41.0	11.0	25.9
Young	11	2	2	18.2	18.2	100.0
Breeds						
Cross breeds	226	95	26	42.0	11.5	27.4
Zebu	110	44	12	40.0	10.9	27.3

Table 3: Risk factors associated with Lumpy Skin disease in cattle in Namisindwa district

Risk factors of LSD	Odds Ratio	Std. Error	z-Statistic	P> z
<i>Constant</i>	.0175775	.0100023	-7.10	0.000
Introduction of new animals	3.897781	3.187333	4.66	0.006
Contact at communal grazing point	10.20908	8.33083	2.85	0.004
Rearing sheep & goats	5.264894	5.868739	1.49	0.136
Challenge with biting flies	1.773285	1.959877	0.52	0.604
Animal trading occurrences	2.130692	2.314266	0.70	0.486
Challenge with ectoparasites	20.0593	17.87639	3.36	0.001
Access to veterinary services	.3611569	.300341	-7.22	0.044
Lack of vaccination	1.577142	1.070752	0.67	0.502
Log likelihood	=	-42.78132		
Number of Obs.	=	316		
LR chi2(8)	=	346.91		
Prob> chi2	=	0.0000		
Pseudo R2	=	0.8022		

Figures

Figure 1

Map showing Namisindwa District with selected sub counties of study (Source: created during this study)

Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

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Figure 2

Contributors of economic loss due to LSD infections in cattle

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Contributors of economic loss due to LSD infections in cattle

Figure 3

Annual distribution of LSD during the time of the outbreak. Going by this figure, the disease incidence coincides with months of rainfall.

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Annual distribution of LSD during the time of the outbreak. Going by this figure, the disease incidence coincides with months of rainfall.