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Full Length Research Paper

An assessment of veterinary diagnostic services needs in Uganda

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The government of Uganda has experienced continued fiscal challenges from late 1980s to date. Consequently, the provision of veterinary services was liberalized and decentralized. This exposed veterinary service provision to many actors without adequate regulation and supervision. With the resurgence of infectious diseases, increased economic and health risks especially to the rural poor, there is the need to understand relational patterns of actors to ensure good governance and address emerging and re-emerging animal diseases risks. A questionnaire surveillance was undertaken in the district veterinary service centres of Uganda to assess the status of veterinary diagnostic services and evaluate their influence in the delivery of clinical and preventive veterinary services. The structure of veterinary diagnostic services in the districts in Uganda is still lacking. There is need to improve veterinary diagnostic service delivery in the districts in an attempt to improve the control of livestock diseases in Uganda to ultimately improve livestock production and productivity and hence household income.

Key words: Veterinary diagnostic services, Uganda.

INTRODUCTION

The history of Veterinary services in Uganda dates back to 1908 when the first British Veterinarian arrived to serve in the protectorate. Prior to this, urgent disease problems were dealt with by the Chief Veterinary Officer in Kenya who took three days to travel from Nairobi to Kampala. Later on, by 1912, the number of animal health specialists in the country increased to five and they were all foreign. The Veterinary Department was made formally responsible for the animal industry in 1921. The Uganda Veterinary service was at first concerned with the control of rinderpest and contageous bovine pleuropneumonia (CBPP), two diseases which continue to be priorities for the veterinary services today (Silkin and Kasirye, 2002). However, due to rigorous vaccination campaign, rinderpest has been eradicated globally.

All the top veterinary posts in the country by 1953 were still dominated by British veterinarians. These prevented the promotion of Africans without British qualifications by the colonial government to positions of Veterinary Officers or Heads of Department. This prompted the African diploma holders of the time to encourage one of their own to pursue further training in the UK. He returned in 1962 as the first veterinary graduate in East Africa, with Membership in the Royal College of Veterinary

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Surgeons. After the establishment of the East African Community (EAC), training shifted between the different campuses of the member states. The Veterinary school moved from Makerere in Uganda to Kabete in Kenya in 1959. It was later in 1962 incorporated into the University of Nairobi awarding the Bachelor of Veterinary Science degree (Mosha et al., 1997). The Assistant Veterinary Officer course in Makerere was abolished in 1962 and consequently, all serving diploma holders were sent to Kabete for a one year up-grading to Bachelors of Veterinary Science. A Veterinary Training Institute in Entebbe began training Animal Husbandry Officers in 1962 on a 2-3 year course in milk and meat production, to work alongside the Veterinary Assistants who were concentrating on animal health. The Faculty returned to the Makerere campus in 1971, and could turn out 30 to 35 veterinary graduates a year (Silkin and Kasirye, 2002). To-date, the faculty was rebranded as the College of Veterinary Medicine, Animal Resources and Bio-Security (COVAB), Makerere University. The college has diversified to a number of animal related study courses both at the undergraduate and postgraduate levels from Bachelors, Masters Degrees to Doctor of Philosophy (PhD).

The Uganda government adopted structural adjustment programs in the 1980s and early 1990s. This resulted in the decentralization and privatization of clinical veterinary services and the downscaling of the civil service (Haan and Umali, 1992). Consequently, clinical services, breeding and spraying for tick control were privatized, while vaccination of animals against epidemic diseases, quarantines and tsetse control were retained under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) (Ilukor et al., 2014). These reforms were intended to reduce the costs of the public administration and to cut public expenditure. Unfortunately, this policy intervention had no impact because various challenges like corruption and the creation of more districts under decentralization resulted in increased public expenditure and stressed the capacity and accountability of both local governments and the central government. Hence the ultimate goal to reduce public administration costs as a proportion of public expenditure did not bear fruit.

Since 2005 to-date, the Ugandan government has been in the process of dividing districts into smaller units. This decentralization is intended to prevent resources from being distributed primarily to chief towns and leaving the remainder of each district neglected (Ocwich, 2005). Each district is further divided into counties and municipalities, and each county is further divided into sub-counties. The head elected official in a district is the chairperson of the Local Council five (usually written with a Roman numeral V). Originally, since independence Uganda had 33 districts divided into 4 regions. The regions of Uganda are known as Central, Western, Eastern, and Northern. These four regions are in turn divided into districts. There were 56 districts in 2002 (Uganda Bureau of Statistics, 2013), which expanded into 111 districts plus one city (Kampala) by 2010 (Ministry of Local Government, 2010).

Uganda lies astride the Equator, between latitudes 4° 12´N and 1° 29´ S and longitudes 29° 34´W, and 35° 0´E. Temperatures are in the range of 15° to 30°C. More than two-thirds of the country is a plateau, lying between 1,000 to 2,500 m above sea level. Precipitation is fairly reliable, varying from 750 mm in Karamoja in the Northeast to 1,500 mm in the high rainfall areas on the shores of Lake Victoria, in the highlands around Mt. Elgon in the east, the Ruwenzori mountains in the south-west and some parts of Masindi and Gulu. Uganda has a total land area of 241,548 km^2; Lakes, swamps and protected areas constitute 25%. More than 75% of the country (over 18 million hectares) is available for both cultivation and pasture. This land resource, together with the bodies of water, are the base upon which most of the 34.9 million Ugandans (2014 census estimates) and their livestock depend for their livelihood. The capacity of this land resource to sustain the rapidly increasing populations largely depends on the influence of edaphic (relief and soil fertility), climatic and biotic factors and how well they can be managed to increase and sustain its productivity. The country can be conveniently divided into seven broad agro-ecological zones which have similar economic and social backgrounds, and in which ecological conditions (soil types, topography, rainfall), farming systems and practices are fairly homogeneous.

Agriculture is the backbone of Uganda's economy; 95% of the population farms (both crops and livestock) on small farms for food and cash income, and on fairly large farms including ranches, of an average size of 1,200 ha and crop farms (5 to 20 ha). Agriculture contributes over 40% to the gross domestic product (GDP) and over 90% to the country's foreign exchange earnings. It also contributes over 60% of total Government revenue in addition to employing more than 80% of the total labour force and providing over half of the total income for the bottom three-quarters of the population (MFP and ED, 1996).

The major livestock species in Uganda include cattle, sheep, goats, pigs, rabbits and poultry. Livestock production is an important sub-sector of agriculture contributing about 7.5% to total GDP or 17% to AGDP. It is estimated that mixed farming small holders and pastoralists own over 90% of the cattle herd and all of the small ruminants and non-ruminant stock; they produce the bulk of domestic milk and slaughter animals. From an economic point of view, cattle are the most important livestock with significant contributions, though to a lesser extent, from goats and sheep. Pig and chicken meat production are also important.

METHODS

We did a needs assessment of Veterinary diagnostic services in

Uganda was conducted from 11th to 15th January, 2010. This was the initial stage of the project "Development of diagnostic tools for livestock diseases in Uganda". Busia, Tororo, Mbale, Kumi, Soroti, Lira, Masindi, Hoima, Kiboga, Mukono, Jinja and Iganga districts were visited. These were representative of the different geographical regions of Uganda including: Eastern, Northern, Western and Central Uganda. A questionnaire was administered to District Veterinary staff at District Veterinary service centres by interviewing District Veterinary Officers (DVOs), Veterinary officers (VOs) and Animal husbandry officers AHOs.

The Veterinary premises at the district headquarters were inspected, checking for laboratories, laboratory instalments, services like water and electricity, waste disposal, among others. Human resource capacity was also investigated at the district in terms of manpower skills and qualifications and capacity for laboratory diagnosis, for instance presence of laboratory technicians.

Ethical clearance

The study was conducted under permission from the National Agricultural Research Organization (NARO, Uganda) and Institutional Ethical and Animal Care guidelines were adhered to during the surveillance exercise.

RESULTS

Common diseases identified included Tick-borne diseases [East Coast Fever (ECF), Anaplasmosis, Babesiosis, Heart water]; Trypanosomosis; Brucellosis; Contageous bovine pleuropneumonia (CBPP); Mastitis; Tuberculosis; Foot and Mouth Disease (FMD); Helminthiasis; Orf; African Swine fever (ASF); Rabies; New castle Disease (NCD); Fowl Pox; Fowl typhoid; Gumboro; Coccidiosis; Bird Flu; Metritis; Mareks.

Methods used for disease diagnosis included: Clinical diagnosis (the most commonly used); farmer or environment; history; post mortem approach; wet, thin and thick, smears; faecal analysis, for example flotation method for faecal analysis; brucella antigen test for brucellosis in a few laboratories (Mbale, Soroti, Masindi); California mastitis test (CMT) (in Kiboga); drug sensitivity test for mastitis (in Kiboga); haematocrit centrifugation technique (HCT). Methods of diagnosis needed included: Basic tests for diagnosis wet, thin and thick, smears, faecal analysis, HCT. They are not being used in some districts either because the staff are not trained or there are no reagents/equipment; serological tests like agglutination tests for the above diseases especially viral diseases; molecular tests like polymerase chain reaction (PCR).

Diagnostic training needs included: Refresher courses to update knowledge on current diagnostic tools for example, PCR; training in laboratory techniques for people working in the laboratory (many of them are animal husbandry officers who are depending on knowledge they acquired during their training); more training in clinical diagnosis (the decision support card will be helpful) Tables 1 and 2.

Challenges in disease diagnosis

1. Lack of laboratory space for some districts.
2. Lack of trained personnel in disease diagnostics for example, technicians. They have resorted to using animal husbandry officers or Veterinary doctors who are not trained in disease diagnosis.
3. Lack of funds for supplies and other necessities for laboratory diagnosis.
4. Lack of equipment.
5. Veterinary staffs are not motivated to carry out disease diagnosis.
6. Farmers are not motivated to support laboratory diagnosis.
7. Lack of confirmatory tests for most diseases- treatment is based on clinical diagnosis and hence not accurate. Result is that animals are exposed to drugs they do not need resulting in drug resistance.

Observations

1. Partnerships are very important for sustaining the district diagnostic services. Most districts with laboratory services had partners like Mbale, Kumi, Kiboga were/are supported by JICA, Jinja Veterinary department is sharing with the medical sleeping sickness laboratory, Masindi Veterinary department staff take their samples to the hospital laboratory for testing, Busia veterinary department make use of the services of the Busia (Kenya) Veterinary department.
2. Donor-supported laboratories will close when the projects end.
3. Due to diagnostics challenges faced by veterinary staff because of lack of diagnostic skills, many of them are interested in undergoing training in diagnostic skills.

DISCUSSION

The status of Veterinary diagnostic services in Uganda is still lacking. Many districts do not have diagnostic laboratories and laboratory technicians. They depend on clinical signs for diagnosis, or they send samples to regional reference laboratories. This is a challenge as it compromises the quality of veterinary provision in Uganda. The skills of the Veterinary staff at the district in addition to the district Veterinary infrastructure are also lacking. There is need to equip the district Veterinary staff with refresher courses in Veterinary disease diagnosis and practice in general. The control of Veterinary diseases is important both for livestock production and productivity but for public health regarding zoonosis control as well since many emerging zoonotic diseases are of animal origin. The lack of established Veterinary diagnostic services and infrastructure (Tables 1 and 2) in addition to laboratory technicians implies that many diseases are left undiagnosed and many economic losses occur and public health casualties in form of

Table 1. Status of District Veterinary diagnostic services in Uganda.

District	Laboratory Yes/No	Laboratory personel	Laboratory equipment								
			Microscope	Centrifuge	Fridge/Freezer	Incubator	Weighing balance	Water bath	Sterilizer	Autoclave	Oven
Tororo	No (since Dec 2008 when celing of their building collapsed)	1 retired last yr, DVO (when he has time & it is a must).	10 (2 phase contrast, 8 light)	2	3 (1 faulty)	2	2?	0	1	1	
Busia	Yes	LA	1	0	1	0	0	0	0	0	0
Mbale	Yes	LA, 2 BVM (trained in diagnostics at Entebbe by JICA)	3	2 (HCT)	1	1	2 (1 digital pocket size)	0	1	1	1
Kumi	Yes	AHO & LA	2	2 (micro and macro)	2 (1 damaged during transportation)	0	0	0	1	0	0
Soroti	Yes	BVM, AHO	2	2 HCT (1 very new)	3 fridge/ freezer, I deep freezer.	0	0	0	1	0	0
Lira	Yes	NIL	1	1	3 (2 in good condition)	0	0	0	0	0	0
Masindi	Yes (non functional)	LA (retiring end of Jan, 2010)	1	1 (HCT)	5 (1 for -80, rest are -20, 4)	0	0	0	0	0	0
Hoima	Yes (about 3 km from their current location, just moved to a new building with no provision for lab)	Lab staff died sept, 2009)	2	2 (manual & electric)	4	0	1	1	1	0	1
Kiboga	Yes (well equiped)	BVM	2	2 (bench)	3 fridge/ freezers, 2 -20 freezers, 1 convertible fridge (kerosene/ electricity)	1	1 (Digital pocket size)	1 (waterbath/ sterilizer	1 (waterbath/ sterilizer	1	0
Luwero	No (for wet smears when very necessary)	BVM	1	0	2	0	0	0	0	0	0
Mukono	Yes	NIL	0	0	1	0	0	0	0	0	
Jinja	No (sharing with trypanosomiasis medical lab)	2 AHOs trained in some diagnostic skills.									
Iganga	No (former offices had but roof removed by heavy storm).	AHO, Ag DVO (mainly for tryps)	1(no x100 eye piece)	1 (HCT)	2	0	0	0	0	0	0

Table 2. Services.

District	Supplies					
	Electricity	Water	Generator	Gas cylinder	Water distillers	NGO/ partners
Tororo	Yes	Tap water	1 (not serviced)	None	None	
Busia	Yes	Tap water	None	None	None	Busia- Kenya Vet department
Mbale	Yes	Tap water	2	1 (13.7)	spoilt	JICA & FAO
Kumi	Yes	Rain water	1		None	JICA
Soroti	Yes	Tap water/ distilled water from Entebbe	spoilt	None	None	None
Lira	Yes	Tap water	1 (very old)		None	None
Masindi	Yes	Buy tap water	None	None	None	None
Hoima	Yes	Mineral water	1		0	Medical lab
Kiboga	Yes	Tap water/ rain water	1	1	0	JICA
Luwero	Yes	Tap water	None	None	None	None
Mukono	Yes	Rain water	None		None	None
Jinja	Yes	Tap water				Medical tryps lab
Iganga	No (but can get from nearby building) their former offices had.	Tap water/ Rain water	None	None	None	None

animal and human zoonotic deaths are left unaccounted for. The root cause of this challenge stems from the Government which decentralised Veterinary services yet district veterinary funding and staff recruitment is crippled. The Veterinary industry in Uganda is not given much attention as more funding and priority are given to other professional sectors. As a result, Veterinary diseases are widely spread and endemic in Uganda. The Government as a consequence cannot export animal products hence lost revenues. Zoonotic diseases are also widely endemic in Uganda, all as a result of the weak veterinary sector and funding in Uganda. Uganda is a country gifted by nature with a conducive environment for agriculture, yet it still suffers poverty, food shortage, shortage of animal protein and cases of malnutrition. Veterinary medicine plays a key role in the control and elimination of Neglected Tropical Diseases; therefore, if not sufficiently funded, disease control is compromised.

RECOMMENDATIONS

1. Regional laboratories should be established to help in solving some of the diagnostic problems especially those that need tests that cannot be availed at every district. This will reduce the costs and time required to take samples to the central Diagnostic laboratory in Entebbe. This will also enable farmers and veterinary staff make the right/timely decisions early enough since sometimes farmers never know the results that come from the tests done in Entebbe and even when the results come they may not be helpful to the farmer because almost all animals may have died and the problem may have been solved by guess work in which case more costs might have been incurred.
2. Veterinarians/Paraveterinarians should be trained in diagnostics skills. Animal Husbandry Officers (AHOs) can be taken for training in diagnostic skills and be taken on to handle laboratory work. This is in case the government (MAAIF/Local govt) cannot adjust its structure to provide fully trained laboratory technicians.

However, there will be need for some motivation to be given to those working in the laboratory since it requires more commitment than field work.
3. Diagnostic tools that are fast, simple and cost effective (especially penside tests) should be developed and disseminated. These do not require a lot of expertise and can even be used by farmers if trained. In addition, these tests may even be affordable by the farmers or given to them at subsidised prices and hence sustainable. Finally, since these tests are fast and simple, it will take a short while to get results and timely/right decisions can be made.
4. Farmers should be trained in good animal husbandry practices since some of the diseases result from poor animal husbandry practices.

Abbreviations

ECF, East coast fever; **CBPP,** contagious bovine

pleuropneumonia; **ASF,** African swine fever; **NCD,** New castle disease; **FMD,** foot and mouth disease; **JICA,** Japan International Development Agency; **FAO,** Food and Agriculture Organization; **DVO,** district veterinary officer; **VO,** veterinary officer; **AHO,** animal husbandry officer; **HCT,** haematocrit centrifugation technique; **Tryps,** trypanosomiasis; **BVM,** bachelor of veterinary medicine; **LA,** laboratory assistant; **PCR,** polymerase chain reaction; **CMT,** California mastitis test; **MAAIF,** Ministry of Agriculture, Animal Industry and Fisheries; **EAC,** East African Community.

Conflict of Interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

Major causes and abnormalities of organ condemnation and financial loss in cattle slaughtered at Dessie municipal abattior North Eastern Ethiopia

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A cross sectional active and retrospective abattoir survey was undertaken from November 2013 to April 2014, on cattle slaughtered at Dessie municipal abattoir with the aim of identifying the major causes of organ condemnation, risk factors for organ condemnation and estimating the financial loss attributed to the condemned organs in cattle slaughtered at Dessie municipal abattoir, North-East part of Ethiopia. Of the total 768 examined animals, abnormalities were detected in 82 (10.68%) during ante mortem inspection and 430 (55.99%) were animals from which organ condemned during postmortem inspection. From the total cattle slaughtered, 311 (40.49%) livers, 142 (18.49%) lungs, 39 (5.08%) kidneys, 34 (4.43%) hearts and 6 (0.78%) tongues were condemned due to various causes. Hydatidosis (22.13%), fasciolosis (20.18%) and cirrhosis (8.85%), hepatitis (4.43%), pneumonia (3.25%), abscess (2.6%), pericarditis (2.08%), edema (1.82%), hydronephrosis (1.43%), nephritis (1.04%) were the major identified causes from the lesions responsible for the rejection of organs. Statistically significant difference in organ condemnation rate was found between age (p = 0.000), body condition score (p = 0.000) and origin (p = 0.013) of animals. However, there was no statistically significant difference between the two breeds although there was higher condemnation rate of organ in cross breed cattle. In the study, fasciolosis and hydatidosis were the major causes of organs condemnation. The direct financial loss from organ condemnation due to various reasons was estimated to be 122,617.70 Ethiopian Birr (6,288.08 USD) per annum. Hence, commencement and implementation of prevention and control measures are must so as to secure from the financial loss they cause.

Key words: Dessie, Ethiopia, Financial loss, major causes, organ condemnation.

INTRODUCTION

Ethiopia has large livestock population in Africa with an estimate of 44,318,877 cattle, 23,619,720 sheep, 23,325,113 goats, 6,000,000 equines, 2,300,000 camels and 43,000,000 poultry (CSA, 2008). Hence, an increase in cattle production could contribute to the attainment of food self-sufficiency in the country particularly in response to protein requirement for the growing human population as well as to enhance the export earnings (FAO, 2007). Abattoirs played an important role in examined for unusual signs, lesions or specific diseases

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surveillance of various diseases of human and animal health importance. Surveillance at the abattoir allows for all animals passing in to human food chain to be (Chhabra and Singla, 2009 and Alton et al., 2010). Monitoring and other conditions at slaughter has been recognized as one way of assessing the disease status of herd, however this source of information is not fully exploited worldwide (Mellau et al., 2010). Abattoir data is an excellent option for detecting diseases of both economic and public health importance (Abunna et al., 2010). Abattoir data can be a source of valuable information on the incidence and epidemiology of animal diseases conditions, to estimate the financial losses incurred through condemnation of affected organs (Raji et al., 2010). An important function of meat inspection is to assist in monitoring diseases in the national herd and flock by providing feedback information to the veterinary service to control or eradicate diseases (Gracey et al., 1999). The main causes of organ condemnation during postmortem inspection are diseases originated by parasites, bacteria and viruses. Flukes in liver and hydatid cyst in lung, liver and kidney, are mainly involved (Mezegebu, 2003). In Ethiopia, many studies have been undertaken to identify the major disease conditions encountered during ante mortem and postmortem inspection and to determine the economic importance of organ and carcass condemnation. Fasciolosis, hydatid cyst, Cysticercus bovis, pneumonia, emphysema, hydronephrosis, cirrhosis, hepatitis, calcification and abscessation were the major causes of organs condemnation in cattle slaughtered at Adigirat municipal abattoir (Alembrhan and Haylegebriel 2013; Singla and Juyal 2014). Genet et al., (2012) from Gonder ELFORA abattoir reported the financial loss due to edible organ and carcass condemnation to be 21,565,849 Ethiopian birr per annum. Fasciolosis and hydatidosis were the major causes for condemnation that led to huge economic losses. By another author, an annual direct financial loss of 154,850.22 Ethiopian birr was estimated in Gondar ELFORA abattoir due to condemnation of edible organs (Yifat et al., 2011). Amene et al., (2012) reported that an estimated average amount of 172,664.09 ETB was lost annually due to organ condemnation of cattle at Jimma Municipal abattoir. Of all the losses, liver condemnation has accounted for the higher proportion (92.7%). Similar economic loss analysis by Fasil, (2009) showed annual economic loss of 150,048.98 ETB at Gondar Municipal abattoir. Another report in cattle slaughtered at Mekele municipal abattoir revealed an estimated annual economic loss of 222,884.58 ETB. Most of the studies conducted in Dessie municipal abattoir have focused only on specific diseases such as fasciolosis and hydatidosis. As a result of this, there is no complete information about causes of organ condemnation at Dessie municipal abattoir. In line with this, it would be essential to have comprehensive information on occurrence of various diseases and causes of organ condemnation and their financial loss to establish appropriate strategy for prevention and controls. Therefore, the objectives of this study were to identify the major causes of organ condemnation, to identify risk factors for organ condemnation and to estimate the direct financial loss attributed to the condemned organs in cattle slaughtered at Dessie municipal abattoir.

MATERIALS AND METHODS

Study area

The study was conducted from November 2013 to April 2014 at Dessie Municipal abattoir. The animals were brought from different areas (Tewuledere, Dessie Zuria, Kutaber and Tenta). Tehuledere is located at the eastern edge of the Ethiopian highlands in the Debub Wollo Zone and the altitude of Tehuledere ranges from 500 meters above sea level along the boundary with the Debub Wollo Zone to 2700 meters along its southwest border. Dessie is the capital of South Wollo Zone situated at the North-east part of Ethiopia at a distance of about 400 km away from Addis Ababa the capital of Ethiopia. Dessie is located at 11 08' North latitude and 39 38' East longitudes and has an elevation of about 2600 meters above sea level. The area gets 936 to 1070 mm Hg rainfall annually. The mean monthly minimum and maximum temperatures are 12.37°C and 26.27°C, respectively (DFEDB, 2007).

Study population and sample size determination

Study population

The study population constitutes of local and cross breed cattle originating from different localities and districts around the town; Tewuledere (midland), Tenta (midland), Dessie Zuria (Highland) and Kutaber (Highland). The majority of animals slaughtered were local breeds and age wise adult animals took the greater proportion.

Sampling and sample size determination

Systematic random sampling technique was used to select the animals to be included in the sample. The required sample size was calculated based on the expected prevalence of 50%, absolute desired precision of 5% and at confidence level of 95% according to the formula provided by Thrusfield, (2005). However, to increase the precision, the sample size was doubled consequently. The total sample size taken for the study was 768 cattle.

$$N = \frac{1.96^2 \times P_{exp}(1 - P_{exp})}{d^2}$$

Where N = Number of sample size, P_{exp} = expected prevalence, d^2 = Absolute precision, CI = Confidence interval (95%)

Therefore the sample size will be;

$$N = \frac{(1.96)^2 \times 0.5\ (1 - 0.5)}{0.05^2} = 384 \times 2 = 768$$

In active abattoir survey, each week four days visit was done for

ante mortem and postmortem examination of slaughter animals.

Study design

The study conducted was basically cross sectional type based on active abattoir survey. Three year retrospective data from the abattoir was also used to estimate the financial loss due to organ condemnation.

Active abattoir survey

Ante mortem examination

During ante mortem examinations, identity tag numbers were given to the selected animals and relevant information including origin (Tehuledera and Tenta as midland while Dessie Zuria and Kutaber Highland), physical condition and health status were recorded. Body condition score of the sample animals were measured and standard grades given as described by Nicholson and Butterworth, (1986). The judgment have also been passed based on the procedure given by FAO, (2007).

Postmortem examination

Postmortem examination was conducted by visualization, inspection, palpation and systematic incision of each visceral organ particularly the liver, lung, heart and kidney for the presence of cysts, various adult parasites and other abnormalities (Gracy, 1999). The pathological lesions were differentiated and judged based on meat inspection guidelines (FAO, 2007).

Assessment of direct financial loss

The total direct financial loss due to organ condemnation was computed or determined by using the condemnation rate of each edible organ that has been determined by this study, the average annual slaughter capacity of the abattoir from three year retrospective data and average current local market price of major organs. Average current local market price of each organ and carcass was collected by questionnaire from the butcheries in Dessie town for ease of computing the loss. Consequently the total financial loss was calculated by the following formula set by Ogunrinade and Ogunrinade (1980).

EL = ἐsrk X Coy X Roz

Where EL - Estimated annual economic loss due to organ/carcass condemnation from international/domestic market, Srx - Annual cattle slaughter rate of the abattoir, Coy - Average cost of each liver/lung/heart/kidney/tongue. Roz - Condemnation rates of liver/lung/heart/kidney/tongue

Data management and analysis

Collected data was entered into Microsoft excel and summarized by descriptive statistical methods like percentage and proportion. Then data was also analyzed by using version 20 of SPSS software. The results of this study were considered statistically significant when P value is less than 0.05.

RESULTS

Abattoir survey

Ante mortem examination

During ante mortem inspection, abnormalities were detected in 82 (10.68%). The major abnormal conditions encountered during ante mortem examination are summarized in the Table 1.

Postmortem examination

In the postmortem inspection, from 430 (55.99%) cattle, different organs were condemned (Table 2). Analysis of potential risk factors with animals from which organ condemned revealed that there is statistically significant difference (P = 0.000), (P = 0.000) and (P = 0.013), between age, body condition score respectively in organ condemnation rate. However, there was no statistically significant difference between breed (P = 0.060). From the total 768 cattle slaughtered, 311 (40.49%) livers were condemned because of various abnormalities or causes of condemnation. Out of these condemned livers, fasciolosis was responsible for 141 (18.36%) liver condemnation followed by cirrhosis 68 (8.85%), hepatitis 34 (4.43%), hydatidosis 31 (4.04%) and the rest rejection rate was due to Fasciolosis + Hydatidosis 14 (1.82%), abscess 10 (1.3%), calcification 7 (0.9%) and *cysticercus bovis* 6 (0.78%). In condemnation rate of liver, there was statistically significant difference (p = 0.019) and (p = 0.017) between the two age groups and among body condition score categories (Table 3). Out of the total cattle slaughtered, 142 (18.49%) lungs were totally condemned because of various abnormalities or causes of condemnation. Out of these condemned lungs, hydatidosis was the cause for 111 (14.45%) of the condemnation followed by Pneumonia 25 (3.25%) and abscess 6(0.78%). There was statistically significant difference (p = 0.017 and p = 0.008) in condemnation rate of lung between age and body condition score categories respectively (Table 4). From the total 768 cattle at slaughtered, 39 (5.08%) kidneys were totally condemned because of various abnormalities or cause of condemnation. Out of these condemned kidneys hydronephrosis was identified as cause for 11(1.43%) followed by hydatidosis 10 (1.3%), Nephritis 8 (1.04%), Calculi 5 (0.65) and cyst 5 (0.65%). There was statically significant difference (p = 0.037) between the body score condition categories in frequencies of causes of kidney condemnation (Table 5a). 34 (4.43%) of hearts were condemned due to various abnormalities. Out of the condemned hearts, Pericarditis was responsible for 16

Table 1. Abnormalities encountered during ante mortem examination.

Abnormalities	No. of animals with abnormalities/etiologies	Prevalence (%)
Ectoparasites	22	2.86
Lacrimation	10	1.3
Lameness	9	1.17
Nasal discharge	7	0.91
Salivation	7	0.91
Branding	6	0.78
Blindness	5	0.65
Fracture	5	0.65
Depression	4	0.52
Localized swelling	4	0.52
Emaciation	3	0.39
Total	82	10.68

Table 2. Over all organ condemnation rate by breed, age, body condition score and origin.

Variables		No. of animals Slaughtered	Animals from which organ condemned	Prevalence (%)	X^2	P - VALUE
Breed	Cross	35	25	71.4	3.55	0.060
	Local	733	405	55.3		
	Total	768	430	55.99	-	-
Age	Adult	477	301	63.1	27.94	0. 000
	Young Adult	291	129	44.3		
	Total	768	430	55.99	-	-
BCS	Good	306	113	36.9	82.13	0.000
	Medium	395	261	66.1		
	Poor	67	56	83.6		
	Total	768	430	55.99	-	-
Origin	Highland	505	299	59.2	6.2	0.013
	Midland	263	131	49.8		
	Total	768	430	55.99	-	-

(2.08%) condemnation followed by Edema 14 (1.82%) and hydatid cyst (0.52%). There was statically significant difference (p = 0.000) between the body score condition categories with frequencies of heart condemnation rate (Table 5b).

Assessment of direct financial loss

The annual direct financial loss due to condemnation of edible organs at Dessie municipal abattoir was estimated to be 122,617.70 Ethiopian birr (6,288.08 USD) (Table 6).

DISCUSSION

The main causes of organ condemnation during postmortem inspection were fasciolosis in the liver and hydatid cyst in the lung (Teka, 1997). In this study 40.49% of livers were condemned because of various abnormalities found during postmortem examination. Among the major causes of liver rejection, 20.18% prevalence of fasciolosis observed in this study is lower when compared with the prevalence of 24.3, 29.6 and 41% reported by Gebretsadik et al., (2009) and Mulat et al., (2012) and Getachew et al., (2006), respectively. The result of the present study is higher than 14.1% from Tanzania by Swai and Ulicky, (2009) and 16.64% by Genet et al., (2012) in Gondor. The difference in the rejection rate of liver due to fasciolosis among this study and the above reports can be mainly attributed to the variation in the climatic and ecological conditions such as altitude, rainfall and temperature as well as the livestock management system among the study areas

Table 3. Disease conditions/causes of condemnation encountered in liver.

Causes of condemnation	Animals as per their age			Animals as per their body condition			
	Adult (477)	Young adult (291)	Total (768)	Good (306)	Medium (395)	Poor (67)	Total (768)
Abscess	5 (1.05)	5 (1.72)	10 (1.3)	4 (1.31)	6 (1.52)	-	10 (1.3)
Calcification	4 (0.84)	3 (1.03)	7 (0.9)	2 (0.65)	5 (1.27)	-	7 (0.9)
Cirrhosis	49 (10.27)	19 (6.53)	68 (8.85)	28 (9.15)	36 (9.11)	4 (5.97)	68 (8.85)
Cysticercosis	3 (0.63)	3 (1.03)	6 (0.78)	2 (0.65)	1 (0.25)	3 (4.48)	6 (0.78)
Fasciolosis	102 (21.38)	39 (13.4)	141 (18.36)	29 (9.48)	80 (20.25)	32 (47.76)	141 (18.36)
Fasciolosis + hydatid cyst	9 (1.89)	5 (1.72)	14 (1.82)	3 (0.98)	10 (2.53)	11 (16.38)	14 (1.82)
Hepatitis	25 (5.24)	9 (3.09)	34 (4.43)	6 (1.96)	23 (5.82)	5 (7.46)	34 (4.43)
Hydatid cyst	21 (4.4)	10 (3.44)	31 (4.04)	4 (1.31)	24 (6.08)	3 (4.48)	31 (4.04)
Total	218(45.7)	93 (31.96)	311 (40.49)	78 (25.5)	185 (46.84)	48 (71.64)	311 (40.49)

X^2 = 18.27; P - value = 0.019, X^2 = 106.31; P - value = 0.017.

Table 4. Disease conditions/causes of condemnation identified in lung.

Causes of condemnation	Animals as per their age			Animals as per their body condition			
	Adult (477)	Young adult (291)	Total (768)	Good (306)	Medium (395)	Poor (67)	Total (768)
Abscess	4 (0.84)	2 (0.69)	6(0.78)	4 (1.31)	2 (0.51)	-	6 (0.78)
Hydatidosis	83 (17.4)	28 (9.62)	111 (14.45)	33 (10.78)	65 (16.46)	13 (19.4)	111 (14.45)
Pneumonia	18 (3.77)	7 (2.4)	25 (3.25)	4 (1.31)	15 (3.8)	6 (8.96)	25 (3.25)
Total	105 (22.01)	37 (12.71)	142 (18.49)	41 (13.4)	82 (20.76)	19 (28.36)	142 (18.49)

X^2 = 12.078; P - value = 0.017, X^2 = 20.71; P - value = 0.008.

Manyazewal et al. (2014). In relation to the BCS of the animals, liver condemnation rate due to fasciolosis was 64.14% in the poor BCS, 22.78% in medium BCS, and 10.46% in good BCS animals. Mulat et al., (2012) reported 52%, in medium body condition animals and 41.7% in good body condition animals. Another similar findings were reported from Gondar abattoir 28.4 and 20.4% and from Debre zeit abattoir 30 and 24% (Yemisrach and Mekonnen, 2012), in medium and good body condition animals, respectively. The results reveal that the weight of animals increase as the parasitic infection decrease which could be due to acquired immunity in the host. Body condition become good as fasciola infection decreases since fasciola worms suck blood and tissue fluid and damage the parenchyma of liver due to the migrating immature worms (Marquardt et al., 2000). Finding of 8.85% of liver condemnation due to cirrhosis is comparable with report of Raji et al. (2010) 10.4% at Zaria abattoir. However, this finding is higher than that of 1.1% reported by Yifat et al., (2011) in Gondar and liver condemnation due to cirrhosis in the present study was lower than 16.05% reported by Nurit et al., (2012) in Kombolcha. In this finding hepatitis was responsible for 4.43% of liver condemnation from the total slaughtered cattle which is higher than the report of 0.6% in Kombolcha by Jemal (2009) and lower than 14.83% in Kombolcha by Nurit et al., (2012). In the present study, the rejection rate of liver due to hydatidosis is 4.04%,

Table 5a. Disease conditions/causes of condemnation identified in kidney and heart by body condition.

Kidney				
Reason of condemnation	Animals as per their body condition			Total (768)
	Good (306)	Medium (395)	Poor (67)	
Cyst	-	4 (1.01)	1 (1.49)	5 (0.65)
Hydronephrosis	2 (0.65)	9 (2.28)	-	11 (1.43)
Hydatidosis	6 (1.96)	3 (0.76)	1 (1.49)	10 (1.3)
Nephritis	-	8 (2.03)	-	8 (1.04)
Calculi	1 (0.33)	4 (1.01)	-	5 (0.65)
Total	9 (2.94)	28 (7.09)	1 (1.49)	39 (5.08)

X^2 = 19.3; P - value = 0.037.

Table 5b. Disease conditions/causes of condemnation identified in kidney and heart by body condition.

Heart				
Reason of condemnation	Animals as per their body condition			Total (768)
	Good (306)	Medium (395)	Poor (67)	
Hydropercardium	1 (0.33)	7 (1.77)	6 (8.96)	14 (1.82)
Hydatidosis	1 (0.33)	2 (0.51)	1 (1.49)	4 (0.52)
Pericarditis	2 (0.65)	9 (2.28)	5 (7.46)	16 (2.08)
Total	4 (1.31)	18 (4.56)	12 (17.91)	34 (4.43)

X^2 = 38.81; P - value = 0.00.

Table 6. Estimated direct annual financial loss.

Organ condemned	Average rejection rate of organs (%)	Average annual slaughtered animals from retrospective data	Average price of organs at local market (ETB)	Annual loss estimation (ETB)
Liver	40.49	4116	55	91,661.26
Lung	18.49	4116	20	15,220.97
Kidney	5.08	4116	35	7,318.25
Heart	4.43	4116	40	7,293.55
Tongue	0.78	4116	35	1,123.67
Total estimated loss	122,617.70			

which is similar to 4.2% in Tanzania by Mellau et al., (2011) and comparable with 3.7% in Gondar by Yifat et al., (2011). The analysis of the result on the bases of age indicated the total liver rejection rate was higher in older animals and a significant difference was observed between the two age groups. This may be due to most of liver diseases are chronic and the older animals are mostly affected by many diseases Mesele et al., (2013). 8.49% lungs were condemned due to various causes. Of those causes, hydatidosis and pneumonia were the most important reason for rejection of lung. The current study result in condemnation of lung by hydatidosis (14.45%) is comparable with the result 19.37% of Shegaw et al., (2009) in Mekelle. This variation in prevalence of hydatidosis could be due to differences in animal husbandry system, back yard slaughtering of animals, lack of proper disposal of infected carcass and the presence of stray dogs and their relations with animals Mesele et al., (2013). In the present study, the overall prevalence of hydatidosis 22.13% is higher than 13.61% by melaku et al., (2012) in Dessie municipal abattoir, 15.2% as reported by Kebede et al., (2009b) in Birre-Sheleko and Dangila abattoirs, 16% in Wolaita Sodo abattoir by Kebede et al. (2009a, c), 32.1% by Gebretsadik Berhe, (2009) in mekelle. These variations in prevalence of the diseases in different areas might be due to variation in the ecological factors that determine the occurrence of the diseases. Different prevalence results may be reported from the same area due to variations in the number of animals examined, the

duration and months of the study period. Varying prevalence figures of hydatidosis have been reported in cattle in Africa by several scholars Gebretsadik et al., (2010). A possible reason for the difference in the prevalence of hydatidosis might be due to the contact between large numbers of stray dogs with the herd of cattle. Dogs, which are the final host for the disease transmission, are used as guards for herds and are routinely fed with uncooked offal which deemed unfit for human consumption (Getaw et al., 2010). Additionally variability could be related with age factors. Other factors like difference in culture, social activities and attitudes to dogs in different regions may contribute to variation (Arbabi and Hooshyr, 2006). In the present study, condemned lung by Pneumonia was 3.25% comparable with 2.45% Genet et al., (2012) at Gondor and lower than 8.8% reported by Raji et al., (2010) in cattle slaughtered at Zaria. A number of factors may explain in the different prevalence of pneumonic lungs, including stress factors such as exposure to dust from the environment or exhaustion during long treks of pastoral livestock in search of pasture and water and when animals are taken to livestock markets or abattoirs and parasitism Benard et al., (2011). In this study, 5.08% kidneys of cattle were totally condemned due to different abnormalities. This finding was closer to 5.77% by Shegaw et al., (2009) in Mekelle and lower than 8.6% reported by Jembere, (2002) at Nazareth abattoir in Ethiopia. However, it was higher from the report of 4.2% by Monaghan and Hannan, (1983). There was statically significant difference ($p = 0.037$) in condemnation rate of kidneys among the body condition score groups.

In this study, 4.43% of heart was totally condemned due to different reasons. This finding was comparable with 3.71% reported by Shegaw et al., (2009) in Mekelle. In the present study, pericarditis accounts 2.08% for the condemnation of heart which is higher than 1.17% reported by Shegaw et al., (2009) in Mekelle. Heart condemnation rate have been statistically significant different ($p = 0.000$) in relation to the body condition which was higher in animals with poor body condition. From the slaughtered cattle, 0.78% of tongues were condemned. The result of this finding coincides with that of 0.9% Shegaw et al., (2009). There is no statistically significant difference between the origin, age, and body condition in rejection rate of tongues.

In the present study the annual direct financial loss due to condemnation of edible organs at Dessie Municipal abattoir was estimated to be 122,617.70 Ethiopian birr (6,288.08 USD), which is comparable with direct financial loss analysis estimated by Fasil, (2009) who reported an annual financial loss of 150,048.98 ETB at Gondar Municipal abattoir. On other hand, the present result is less than the estimation by Amene et al., (2012). He reported 172,664.09 ETB annual losses due to organ condemnation from cattle at Jimma Municipal abattoir. Another report in cattle slaughtered at Mekele municipal abattoir revealed an estimated annual economic loss of 222,884.58 ETB, which is certainly higher than the financial loss estimated by the present study. The difference in the financial loss estimated in various abattoir and/or parts of Ethiopia would be due to the variations in the prevalence of disease, mean annual number of cattle slaughtered in the different abattoirs and also the variation in the retail market price of organs Arbabi and Hooshyar, (2006).

Conclusion

In accordance with the results of this study, fasciolosis, hydatidosis, pneumonia, Abscess, pericarditis and hydronephrosis were the major causes for organ condemnation. There was higher overall organ condemnation rate in adult than in young adult, poor body condition animals than the other body condition score categories and in animals from highland than midland origin and this difference was statistically significant. The organ condemnation rate determined by this study incurred in substantial financial loss which is about 122,617.70 ETB per annum. Hence, this study is valuable for the country by providing information on disease conditions most frequently occurring in the study area and organs condemned by those lesions/disease conditions which have public health hazard and aesthetic value. Therefore, further studies should be conducted especially in assessing the indirect losses.

Conflict of Interests

The authors have not declared any conflict of interests.

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Prevalence of bovine trypanosomosis and its vector apparent density in Chora District of Illuababora Western Oromia, Ethiopia

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Bovine trypanosomosis is transmitted by tsetse and other biting flies which cause the most serious veterinary and animal production problem in sub-Saharan Africa. Cross sectional study was conducted from September to December, 2013 in Chora district, Western Oromia to assess the prevalence of trypanosomosis and apparent density of its vector. The methods employed during the study were deploying trap for the collection of tsetse flies and buffy coat technique for parasitological study. About 45 monopyramidal baited traps were deployed for 48 h for collection of tsetse fly. In the study area tsetse flies *Glossina pallidepes* and *Glossina tachnoides* and other biting flies were trapped. *G. pallidepes* was caught at altitude of about 2000 m a.s.l. The overall apparent density of the tsetse flies was 2.63 flies/trap/day. Blood samples collected from 384 cattle were centrifuged and examined under microscope. It revealed that *Trypanosoma congolense* 46(12.0%), *Trypanosoma vivax* 3(0.8%), no infection of *Trypanosoma brucei* and mixed infection 3(0.8%) of the two trypanosomes species were the causes of bovine trypanosomosis in the study area. The overall prevalence of bovine trypanosomosis was 13.6%. The female cattle were infected with the prevalence of 35(9.2%) than male cattle 17(4.4%) and this association was insignificant (P > 0.05). The prevalence of trypanosomosis in adult and poor body condition cattle were 49(12.8%) and 20(5.2%), respectively and significantly associated (P < 0.05) with prevalence of trypanosomosis. The red colour cattle were mostly affected 22(5.7%) and insignificantly associated (P > 0.05). Aneamic and non-aneamic cattle have trypanosomes infection rate of 43(11.2%) and 9(2.34%), respectively. Aneamic cattle were significantly associated (P < 0.005) with the prevalence of trypanosomosis, but non-aneamic cattle were insignificantly associated (P > 0.05). Generally, the study concludes that tsetse flies were an important vector for the epidemiology of bovine trypanosomosis in Chora district. Therefore, disease and its vector control and prevention methods and further studies on the trypanosomal drug resistance should be undertaken to improve livestock production and productivity in the study area.

Key words: Prevalence, trypanosomosis, apparent density, tsetse flies, cattle, Chora district.

INTRODUCTION

Bovine trypanosomosis is transmitted by tsetse and other biting flies which cause the most serious veterinary and animal production problem in sub-Saharan Africa and prevents the keeping of ruminants and equines on over 10 millions of square kilometers of potentially productive land. This study is the road map and contribution to the

Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC) Agenda (Pan African Tsetse and Trypanosomosis Eradication Campaign (PATTEC), 2001). Tsetse flies in Ethiopia are confined to southwestern and northwestern regions between longitude 33° and 38°E and latitude 5° and 12°N covers an area of 220,000 km². Tsetse infested areas lie in the lowlands and also in the river valleys of Abay (Blue Nile), Baro, Akobo, Didessa, Ghibe, and Omo (National Tsetse and Trypanosomosis Investigation and Control Center, 2004). Consequently, new areas are being invaded and settled communities are being continually expelled by the advancing tsetse. Five species of *Glossina* (*G. m. submorsitans, G. pallidipes, G. tachinoides, G. f. fuscipes and G. longipennis*) have been recorded in Ethiopia (Langridge, 1976).

Bovine trypanosomosis is one of the diseases that are caused by flagellated protozoan parasites which belong to the genus *Trypanosoma*. *Trypanosoma* is a unicellular parasite found in the blood and other tissues of vertebrates including livestock, wild life and people (Uilenberg, 1998). The species of trypanosomes are known to exist in Ethiopia, which are pathogenic to cattle, are *Trypanosoma congolense, Trypanosoma vivax* and *Trypanosoma brucei*. They are distributed mainly in tsetse belt region of the Ethiopia. However, *T. vivax* is also found in areas outside of the tsetse belt, where it can possibly be transmitted by mechanical vectors of biting flies (Langridge, 1976; Abebe and Jobre, 1996). According to National Tsetse and Trypanosomosis Investigation and Control Center (National Tsetse and Trypanosomosis Investigation and Control Center, 2004), tsetse transmitted animal trypanosomosis still remain as one of the largest cause of livestock production losses in Ethiopia. In Chora district, trypanosomosis was found to be one of the factors that hinder livestock rearing in most of its peasant associations. However, hard evidence on the occurrence of tsetse and trypanosomosis in the area is lacking (Cecchi et al., 2015; Cecchi et al., 2014).

Therefore, the objectives of the present study were to assess the prevalence of bovine trypanosomosis and its vector apparent density in Chora district of Western Oromia, Ethiopia.

MATERIALS AND METHODS

Study area, population and Sample size determination

The study was conducted from September to December, 2013 in Chora district, Western Oromia, which is situated at 500 km West of Addis Ababa in Ilu Aba Bora Zone. The mean annual rainfall in Chora district ranges from 1000 to 1500 mm. The annual temperature ranges from 15 to 31°C. The altitude of the area ranges from 1,000 to 2060 m a.s.l. The Geba forest which is registered on the United Nations Educational, Scientific, and Cultural Organization (UNESCO) for its natural habitats is located in the study area. The area has a number of wild animals, such as African buffaloes, Bush pigs, warthog, bush buck, kudu, hippopotamus, crocodiles, hyena, antelopes and snakes which are claimed to serve as sources of food for the vector of trypanosomes.

The cattle in the district are local breeds that are kept under traditional extensive husbandry systems with communal herding. Agriculture is the main livelihood of the society with mixed farming system and livestock play an integral role for agriculture. The district has 20 peasant associations. The animal population of the district is estimated to be 105,500 cattle, 38,100 sheep, 22,987 goats, 6,881 Horses, 2,295 Mule and 1,735 donkeys in 2012. Sample size was determined using 95% confidence level, 50% expected prevalence and 0.05 desired absolute precision using the formula described by Thrusfield (Thrusfield, 1995). Therefore, a total of 384 cattle were randomly examined for bovine trypanosomosis.

Study design and protocol

Chora district was selected purposely based on the extent of the existing problems, the complaints of farmers and the level of medium to high tsetse challenge in the area from the report of the field veterinarian in the district. A cross-sectional study design was engaged and three peasant associations were selected based on the veterinary reports of the trypanosomosis and tsetse infestation in the district. The cattle age was categorized as good, medium and poor. Body condition score was categorized as young (< 3 years old), adult (3 to 9 years old) and old (> 9 years old) according to Nicholson and Butterworth (Nicholson and Butterworth, 1986).

Sample collection for assessment the prevalence of bovine trypanosomosis

Buffy coat technique was used for the determination of bovine trypanosomosis prevalence. Blood sample collection was performed by piercing the marginal ear vein with a sterile lancet and blood was drawn by a heparinized capillary tube. Then one end (the heparanized end) of capillary tubes were sealed with crystal sealant and centrifuged at 12,000 rpm for five minutes to separate the blood cells and to concentrate trypanosomes using centrifugal forces. Then the packed cell volume (PCV) was determined by packed cell volume reader and recorded. The PCV value ≥ 25 and < 25 were considered as non-aneamic and aneamic, respectively. The capillary tubes were then broken just below buffy coat using diamond pencil and expressed on microscopic slide and covered with a cover slip. It was examined under 40× objective of microscope to identify and detect the presence of the parasites (Murray et al., 1977).

Entomological survey

For the entomological survey a total of 45 monopyramidal baited traps were deployed along Geba river and its tributaries as well in the savannah, about 2000 m a.s.l. altitude to assess the apparent density, distributions and species of tsetse flies and other biting flies involved in transmission of trypanosomosis. All traps were baited with acetone, Octenol (1-3-Octane) and cow urine filled in

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separated bottles and labeled and deployed at an interval of 200 to 250 m. After 48 h of trap deployment, the cages were collected and captured flies were identified and sexed according to morphological characteristics, and counted. The tsetse flies were identified as species level and the other biting flies as the genus level. The apparent density was determined based on the mean catches of flies in traps deployed and expressed as the number of fly catch/trap/day (Leak, 1999).

Data management and analysis

Raw data were entered into a Microsoft Excel spreadsheet and descriptive statistics were used to summarize the data. The prevalence was calculated for all data as the number of infected individuals divided by the number of individuals examined and multiplied by 100. The association between the prevalence of trypanosome infection and risk factors were assessed by chi-square, whereas the student's *t*-test was used to assess the difference in mean PCV between trypanosome positive, negative and overall examined animals. All statistical analyses were conducted using SPSS version 20.0 software. The test result was considered significant when the calculated *p*-value was less than 0.05. The apparent density of fly population was calculated by dividing the number of flies caught by the number of traps deployed and the number of days of deployment and expressed as fly/trap/day (FTD).

RESULTS

Trypanosomosis survey result

Buffy coat collected from 384 cattle were centrifuged and examined under microscope. Bovine trypanosomosis in the study area was caused by *T. congolense* 46(12.0%), *T. vivax* 3(0.8%), no infection of *T. brucei* and mixed infection 3(0.8%) of the two trypanosomes species. The female cattle were infected with the prevalence of 35(9.2%) than male cattle 17(4.4%) and insignificantly associated ($P > 0.05$). The prevalence of trypanosomosis in adult and poor body condition cattle were 49(12.8%) and 20(5.2%), respectively and significantly associated ($P < 0.05$) with prevalence of it. The red colour cattle were mostly affected 22(5.7%) and insignificantly associated ($P > 0.05$) (Table 1). Aneamic and non-aneamic cattle had trypanosomes infection rate of 43(11.2%) and 9(2.34%), respectively. Infection rate of *T. congolense* in aneamic and non-aneamic cattle were 37(9.6%) and 9(2.34%), respectively. Aneamic cattle were highly significantly associated ($P < 0.005$) with the prevalence of trypanosomosis, but non-aneamic cattle were insignificantly associated ($P > 0.05$) (Table 2).

Heamatological result

Blood samples collected from cattle were centrifuged by heamatocrit centrifuge and its PCV was read by PCV reader. Mean of overall, parasitic and aparasitic PCV were 23.92±5.591, 19.02±5.425 and 24.68±5.224, respectively and significantly associated $P < 0.05$ (Table 3).

Entomological survey result

In the study area, tsetse flies *G. pallidepes* and *G. tachnoides* and other biting flies Tabanus, Stomoxys and Heamatopota were trapped. *G. pallidepes* was caught at altitude about 2000 m a.s.l. (Tables 4 and 6). The overall apparent density was 2.63 flies/trap/day of the tsetse flies in Chora district. The Peasant Associations Sololo, Chirache and Hawayember tsetse flies apparent density was 6.47, 1.2, 0.23 flies/trap/day, respectively Table 5 to 7. Sex identification was performed on 237 tsetse flies caught in the study area and counted. The male and female sex was 113 and 124, respectively. Apparent density in flies/trap/day of biting flies Stomoxys, Heamatopota and Tabanus was 2.51, 0.08 and 0.02, respectively (Table 7).

DISCUSSION

This study indicated that from 45 monopyramidal baited traps deployed in the study area for 48 h, the *G. pallidepes* (183) and *G. tachnoides* (54) and other biting flies were trapped. Hence, *G. pallidepes* was caught at altitude of about 2000 m a.s.l. It shows that *G. pallidepes* moves for the search of food to the high altitudes. The overall 2.63 flies/trap/day apparent density of the tsetse flies was recorded in Chora district. This finding is lower than the previous report 19.14 flies/trap/day in Daramallo District by Ayele et al. (2012) and 14.97 flies/trap/day report in selected villages of Arbaminch by Wondewosen et al. (2012). This difference could be attributed to environmental conditions, agro ecological differences and during the study the season was dry in the study area. Among the Peasant Associations, Sololo peasant association was severely affected with tsetse flies of apparent density 6.47 flies/trap/day. Sex identification was performed on 237 tsetse flies caught in the study area and counted. The female tsetse flies (124) were dominantly caught than male ones (113). This indicates that female tsetse flies are playing important role in the cyclical transmission of Trypanosomosis than male tsetse due to the fact that female tsetse demands more blood when pregnant to feed their larva (Urquhart et al., 2006). Apparent density of biting flies in flies/trap/day of Stomoxys, Heamatopota and Tabanus was 2.51, 0.08 and 0.02, respectively. It shows that other biting flies are playing important role in the non-cyclical transmission of trypanosomosis in the study area.

Blood samples collected from 384 cattle were centrifuged and examined under microscope. Bovine trypanosomosis in the study area was caused by *T. congolense* 46(12.0%), *T. vivax* 3(0.8%), no infection of *T. brucei* and mixed infection 3(0.8%) of the two

Table 1. Risk factors with the prevalence of Trypanosomosis.

Risk factors		Non infected Cattle (%)	Prevalence of trypanosomosis				X^2-value	df	P-value
			Mixed Infection (%)	T.C. (%)	T.V. (%)	Total (%)			
Sex	Female	181(47.1)	3(0.8)	29(7.6)	3(0.8)	35(9.2)	5.934[a]	3	0.115
	Male	151(39.3)	0(0.0)	17(4.4)	0(0.0)	17(4.4)			
	Total	332(86.4)	3(0.8)	46(12.0)	3(0.8)	52(13.6)			
Age	Adult	241(62.8)	3(0.8)	44(11.5)	2(0.5)	49(12.8)	54.368[a]	6	0.000
	Old	2(0.5)	0(0.0)	0(0.0)	1(0.3)	1(0.3)			
	Young	89(23.2)	0(0.0)	2(0.5)	0(0.0)	2(0.5)			
	Total	332(86.4)	3(0.8)	46(12.0)	3(0.8)	52(13.6)			
BSC	Good	140(36.5)	0(0.0)	15(3.9)	1(0.3)	16(4.2)	22.358[a]	6	0.001
	Medium	137(35.7)	3(0.8)	13(3.4)	0(0.0)	16(4.2)			
	Poor	55(14.3)	0(0.0)	18(4.7)	2(0.5)	20(5.2)			
	Total	332(86.5)	3(0.8)	46(12.0)	3(0.8)	52(13.6)			
Colour	Black	21(5.5)	0(0.0)	5(1.3)	0(0.0)	5(1.3)	24.323[a]	15	0.060
	Brown	44(11.5)	0(0.0)	5(1.3)	0(0.0)	5(1.3)			
	White and black	31(8.1)	0(0.0)	6(1.6)	0(0.0)	6(1.6)			
	Grey	58(15.1)	3(0.8)	7(1.8)	1(0.3)	11(2.9)			
	Red	174(45.3)	0(0.0)	20(5.2)	2(0.5)	22(5.7)			
	White	4(1.0)	0(0.0)	3(0.8)	0(0.0)	3(0.8)			
	Total	332(86.5)	3(0.8)	46(12.0)	3(0.8)	52(13.6)			

BSC = Body condition score, T.V. = *Trypanosoma vivax*, T.C. = *Trypanosoma congolense,* df = Degree of freedom, Mixed infection = *Trypanosoma vivax* and *Trypanosoma congolense*. X^2 = Chi-square.

Table 2. Prevalence of trypanosomosis in aneamic or non-aneamic cattle.

Parameter	Non-infected (%)	Prevalence of Trypanosomosis				X^2-value	df	P-value
		Mixed infection (%)	T.C. (%)	T.V. (%)	Total (%)			
Aneamic PCV<25	148(38.5)	3(0.8)	37(9.6)	3(0.8)	43(11.2)	108.973[a]	42	0.000
Non-aneamic PCV≥25	184(47.9)	0(0.00)	9(2.34)	0(0.00)	9(2.34)	19.375[a]	15	0.197
Total	332(86.5)	3(0.8)	46(12.0)	3(0.8)	52(13.6)	-	-	-

PCV = Packed Cell Volume, T.V. = *Trypanosoma vivax*, T.C. = *Trypanosoma congolense,* df = Degree of freedom, Mixed infection = *Trypanosoma vivax* and *Trypanosoma congolense, X^2* = Chi-square.

Table 3. Mean of packed cell volume (PCV) of overall, aparasitic and parasitic cattle.

Parameter	Sample size	Mean	Standard deviation	Std. error mean	t	df	P-value	Mean difference	95% confidence interval of the difference	
									Lower	Upper
Overall PCV	384	23.92	5.591	0.285	83.851	383	0.000	23.924	23.36	24.49
Parasitic	52	19.02	5.425	0.752	25.281	51	0.000	19.019	17.51	20.53
Aparasitic	331	24.68	5.224	0.287	85.950	330	0.000	24.680	24.11	25.24

Table 4. Trap deployed in sololo peasant association and tsetse flies caught.

Longitude	Latitude	Altitude in meter	*G.tachnoides*		*G.pallidipes*		stomoxys	Tabanus
			F	M	F	M		
E036°00.058’	N08°24.256’	1371	4	3		2	50	
E036°00.011’	N08°24.280’	1372						
E035°59.989’	N08°24.337’	1380			24	44		
E036°00.069’	N08°24.282’	1388	2	9	2	1		1
E036°00.096’	N08°24.296’	1422			1		3	
E036°00.101’	N08°24.317’	1405	6	24	5	7		
E036°00.759’	N08°24.425’	1559			18	6	20	1
E036°00.699’	N08°24.406’	1488			20	4		
E036°07.319’	N08°21.614’	2014			5	2		
E036°01.543’	N08°24.952’	1657				1	20	
E036°01.920’	N08°24.963’	1668			1		40	
E036°01.894’	N08°24.965’	1665						
E036°01.869’	N08°24.978’	1654					50	
E036°01.873’	N08°24.987’	1642					5	
E036°01.865’	N08°25.014’	1658			3			

Table 5. Trap deployed in chirache peasant association and tsetse flies caught.

Longitude	Latitude	Altitude in meter	G.tachnoides		G.pallidipes		stomoxys	Tabanus	Heamatopota
			F	M	F	M			
E036°02.904’	N08°26.425’	1579	2	4					3
E036°02.949’	N08°26.411’	1607			2				
E036°02.959’	N08°26.367’	1624			2	3			
E036°02.907’	N08°26.360’	1588							1
E036°02.876’	N08°26.324’	1586				1			1
E036°02.864’	N08°26.270’	1593							
E036°02.892’	N08°26.265’	1596			2	4	2		
E036°02.906’	N08°26.304’	1617				3			1
E036°02.931’	N08°26.506’	1591			5	2			
E036°02.945’	N08°26.611’	1626			1				
E036°02.948’	N08°26.568’	1610			3	1			
E036°02.942’	N08°26.534’	1606							
E036°02.955’	N08°26.699’	1616				1			
E036°02.974’	N08°26.695’	1619							
E036°03.052’	N08°26.687’	1631					2		1

trypanosomes species. The previous results reported by Tewelde et al. 2004 at Kone and Village I settlement areas of West Ethiopia, Woldeyes and Aboset (Woldeyes and Aboset, 1997) at Arbaminch zuria districts and

Table 6. Trap deployed in hawa yember peasant association and tsetse flies caught

Longitude	Latitude	Altitude in meter	G.tachnoides		G.pallidipes		Stomoxys	Tabanus
			F	M	F	M		
E036°04.227'	N08°19.941'	1745				1	5	
E036°04.354'	N08°19.958'	1763			2			
E036°04.427'	N08°20.002'	1788				1		
E036°04.589'	N08°20.123'	1808						
E036°04.761'	N08°20.073'	1815					2	
E036°04.589'	N08°20.365'	1826						
E036°04.842'	N08°20.405'	1831						
E036°04.862'	N08°20.507'	1840					6	
E036°05.319'	N08°21.614'	2014			1		3	
E036°05.543'	N08°21.952'	1657			1		5	
E036°05.920'	N08°21.963'	1667						
E036°05.894'	N08°21.965'	1665			1		10	
E036°05.869'	N08°21.978'	1654					2	
E036°05.873'	N08°21.987'	1642						
E036°05.865'	N08°21.014'	1658					1	

Table 7. Apparent density of flies in the district according to peasant association.

Peasant association	Tsetse flies caught						Other biting flies					
	G. tachnoides		*G. pallidipes*		Apparent density		Stomoxys		Tabanus		Heamatopota	
	M	F	M	F	T	FTD	T	FTD	T	FTD	T	FTD
Sololo	12	36	79	67	194	6.47	188	6.27	2	0.07	0	0
Chirache	2	4	15	15	36	1.2	4	0.13	0	0	7	0.23
Hawa yember	0	0	5	2	7	0.23	34	1.13	0	0	0	
Total	14	40	99	84	237	2.63	226	2.51	2	0.02	7	0.08

G. tachnoides = *Glossina tachnoides, G. pallidipes* = *Glossina pallidipes,* M = male, F= female, FTD = flies/trap/day, T = total.

Rowland et al. (1993) in Ghibe valley, south West Ethiopia showed the dominancy of *T. congolense* infection in agreement with present study. The predominance of *T. congolense* infection in cattle may be due to the high number of serodems of *T. congolense* as compared to *T. vivax* and the development of better immune response to *T. vivax* by the infected animal (Leak, 1999).

The prevalence of bovine trypanosomosis was assessed between sexes of cattle and among 52 trypanosome positive animals; female and male cattle were 35(9.2%) and 17(4.4%), respectively. This specified that the female cattle harbor more infection than male cattle 17(4.4%) and insignificantly associated ($P > 0.05$) with trypanosomosis prevalence. This finding is divergent from the previous reports by Getachew (1993), Tefera (1994), Daya and Abebe (2008), Adane (1995), Wondewosen et al. (2012) and Wellde et al. (1979) that shows both male and female cattle were equally susceptible to trypanosomosis infection.

The prevalence of trypanosomosis in adult cattle 49(12.8%) were the most, followed by young 2(0.5%) and old cattle 1(0.3%) and significantly associated ($P < 0.05$) with prevalence of trypanosomosis. This is due to adult cattle movement through tsetse infested areas for the purpose of ploughing, marketing and grazing. The occurrence of trypanosomosis in three different body condition scores (poor, good and medium) animals shows the highest prevalence in poor body condition 20(5.2%) followed by medium 16(4.2%) and good body condition 16(4.2%) and significantly associated ($P < 0.05$) with prevalence of trypanosomosis. This result is similar with the report by Wondewosen et al. (2012) which stated that highest prevalence of trypanosomosis occurred in poor body condition cattle. It was due to the fact that poor body condition animals are highly susceptible to diseases.

Comparison conducted between the different skin color of cattle indicated that slightly highest frequency was observed in cattle having red skin color 22(5.7%) followed by 11(2.9%) in grey, 6(1.6%) in white and black, 5(1.3%) in black, 5(1.3%) in brown and 3(0.8%) in white skin color and insignificantly associated ($P > 0.05$). Tsetse flies by nature are attracted toward a black color but in animals having black skin color there was low prevalence of trypanosomosis recorded in this study,

area. The possible suggestion for the low prevalence in black skin color cattle in the current study may be the low number of samples taken from black skin color animals.

Aneamic cattle which are those with PCV < 25 have trypanosomes infection rate of 43(11.2%), but non-aneamic cattle which have PCV ≥ 25 have trypanosomes infection rate of 9(2.34%). This study revealed that anaemia is the principal sign of trypanosomosis in livestock (Gardiner, 1989). Infection rate of *T. congolense* was higher in aneamic cattle 37(9.6%) than non-aneamic cattle 9(2.34%). Aneamic cattle were significantly associated ($P < 0.005$) with the prevalence of trypanosomosis, but non-aneamic cattle were insignificantly associated ($P > 0.05$).

Blood samples collected from cattle were centrifuged by heamatocrit centrifuge and its PCV was read by PCV reader. Mean of overall, parasitic and aparasitic PCV were 23.92±5.591, 19.02±5.425 and 24.68±5.224, respectively and significantly associated $P < 0.05$. However, trypanosomosis infection and mean PCV values obtained in this study of parasitic and aparasitic cattle were in agreement with the report of Rowlands et al. (1993) in Ghibe valley at South Western Ethiopia, in which was stated that the average PCV of parasitologically negative animals was significantly higher than the average PCV of parasitological positive animals.

In the total cattle populations sampled during study period, 49.74% of cattle populations have PCV < 25. Almost 77.5% of cattle having PCV < 25 reacted negatively for trypanosomosis infection and this may have occurred due to the inadequacy of the detection method used (Murray et al., 1977) or delayed recovery of anemic situations after recent treatment with trypanocidal drugs or may be due to the compound effect of poor nutrition and hematophagous helminth infection, such as haemonchosis and bunostomiasis (Afework, 1998). However, PCV values can be affected by many factors other than trypanosomosis. These factors are likely to affect both trypanosomosis negative and positive animals (Van den Bossche and Rowlands, 2001).

The present study also revealed that almost 4.66% of the cattle have a PCV value in the normal range (PCV ≥ 25) but they react positively to trypanosomosis infection and this may have occurred due to recent infection with trypanosomosis. This result agrees with the previous result of Garoma (2009) who concluded that cattle having PCV value of normal range were shown to be infected with trypanosome parasite.

CONCLUSION AND RECOMMENDATIONS

Trypanosomosis is the disease transmitted mainly by tsetse flies. This study revealed that *G. pallidepes* and *G. tachnoides* were dominant in the area with the 2.63 flies/trap/day overall apparent density and *G. pallidepes* was trapped about 2,000 m a.s.l. in the study area. Blood samples collected from 384 cattle were examined for trypanosomosis which shows that *T. congolense* and *T. vivax* were the causes of bovine trypanosomosis in the study area and aneamia is the cardinal sign of the trypanosomosis. The overall prevalence of trypanosomosis was 13.6%. Bovine trypanosomosis is an important disease and a potential threat affecting the health and productivity of cattle in the district.

Therefore, regular and continuous control and prevention of the vector and disease should be undertaken. Further studies should be conducted on the area of Trypanosomosis drug resistance.

Conflict of Interests

The authors have not declared any conflict of interests.

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