BUSITEMA UNIVERSITY
Pursuing Excellence

PREVALENCE OF BOVINE TRYPANOSOMOSIS IN ZEBU CATTLE IN LABONGO AKWANG SUB COUNTY

KITGUM DISTRICT

BY

KOMAKECH RICHARD

BU/UG/2011/237

makeche50@gmail.com

A DISSERTATION SUBMITTED TO THE FACULTY OF AGRICULTURE AND ANIMAL SCIENCES IN PARTIAL FULFILLMENT FOR THE AWARD OF A BACHELOR DEGREE IN ANIMAL PRODUCTION AND MANAGEMENT OF BUSITEMA UNIVERSITY

JUNE 2014

DECLARATION

I **KOMAKECH Richard** hereby declare that this dissertation represents my work and has not previously been submitted for a degree at this or any other university.

Signed.....

Date..... 8th - July - 2014

APPROVAL

This dissertation has been submitted with the approval of my academic supervisor:

Dr. Zirintunda Gerald (BVM, M.Sc. (IAH)

Department of animal production and management

Faculty of agriculture and animal sciences

Busitema University, Arapai campus

P.O. Box 203

Soroti –Uganda.

Signature..... Date..15-07-2014.....

DEDICATION

I dedicate this work to my Mother Adong Magdalene, my father Gabriel Oloya (RIP), my sister Ayaa Immaculate and brothers (Anywar Mathew and Tabu Robert)

ACKNOWLEDGEMENT

I would like to acknowledge the support and contribution of the District veterinary Office of Kitgum and the support of the staffs especially Olara Gerald Jolly and Ojok Denis

I would like to express my profound gratitude to the staff of animal production and management of Busitema University especially Dr. Okwany Patrick, Ms. Akullu Jolly, Dr. Omadang Leonard, Dr. Matovu Henry, Dr. Ekou Justine and other lecturers.

I am particularly thankful to my supervisor, Dr. Zirintunda Gerald for dedicating his time and energy so that this dissertation is made to a standard.

I owe my gratitude to my friends like Olango Patrick Okot, Ewaju Emmanuel and others.
Above all I thank the almighty God for caring and blessing me in my studies.

TABLE OF CONTENTS

CONTENTS

LIST OF ABBREVIATIONS

AAT	African Animal Trypanosomosis
D.V.O	District Veterinary Officer
ELISA	Enzyme-Linked Immunosorbent Assay
FAO	Food and Agricultural Organisations
KDLG	Kitgum District Local Government
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MDGs	Millennium Development Goals
NGOs	Non-Governmental Organisations
NLPIP	National Livestock Productivity Improvement Project
NLPIP	Nation Livestock Productivity Improvement Programmes
OIE	Organisation Internationale Epizotes (World Organisation for Animal Welfare)
PAAT	the Program against African Trypanosomosis
PAHO	Pan American Health Organisation
PATTEC	Pan African Tsetse and Trypanosomosis Eradication Campaign
PCR	Polymerase Chain Reaction
UBOS	Uganda Bureau of Standards
W.H.O	World Health Organisation

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Bovine trypanosomosis is one of the major threats to the cattle productivity in Kitgum district, Akwang Sub County. However, treatments and controls of the disease had been done without determining the prevalence of trypanosome in the animals.

A cross sectional study was conducted in Akwang Sub County, Kitgum district, Uganda to determine prevalence of bovine trypanosomosis among zebu cattle. The study was done from the months of February to April 2014. Blood samples were collected from 112 randomly selected zebu breed of cattle in three parishes (Lamit parish, Pajimo parish and Lugwar parish) of Akwang Sub County. A total of 48, 44 and 20 Zebu cattle were examined from Lamit, Pajimo and Lugwar parish respectively. Giemsa stained thin blood smear examination technique was used for parasite detection and identification.

The overall prevalence was 16.96% (19/112). The prevalence in Lamit, Pajimo and Lugwar parish were 27.08%, 11.36% and 5.00%, respectively with a statistical significant difference ($P < 0.05$) (X^2=6.501, p= 0.0387) among them. The statistical analysis revealed that no significant difference ($P > 0.05$,) (X^2=0.025, p=0.874) in prevalence was found between male (16.32%) and female (17.46%) animals. The prevalence was (14.705 %) and (17.948%) in young and mature cattle, respectively with no significant difference ($P >0.05$) (X^2=0.177, p=0.673) between them.

According to this study it showed that trypanosomosis is the major threat for livestock production in the study area. The overall prevalence of 16.96% bovine trypanosomosis recorded in the present study is a sign that the disease is a threatening factor to cattle production in the study area. The prevalence of bovine trypanosomosis was higher in female than in males and higher in mature cattle than in the younger ones. Research needs to be carried to confirm why the prevalence rate was low in young and male animals unlike in the mature and the female zebu cattle.

Generally, more research should be provided to both the disease vector and disease. Creation of Awareness to the cattle keepers especially on the disease effects on livestock productivity and the methods of control shall be very important in the studied area. This study further recommends that farmers should concentrate more in keeping the male zebu cattle than the

female animals since they use the male animals as source of draught power in their homes. More study on the occurrence of trypanosomosis in different age groups and sexes of animals should be conducted.

Key words: Cross sectional, Prevalence, Trypanosomosis, Giemsa, Akwang Sub County.

CHAPTER ONE INTRODUCTION

1.0 Background

Livestock production in Uganda contributes about 1.9 percent of the total value of 23.2 percent GDP (UBOS, 2013). Formal export earnings of live animal of the fiscal year 2012/2013 were about 0.1% (UBOS, 2013). The greater attribute to this reduction in the export earnings from 2009-2012 was due to diseases that were major constraints to the production in the pastoral and agro pastoral areas of the country this was further supported by research findings that was done in the recent past. The most notable nuance was the Bovine Trypanosomosis (Ocaido *et al.*, 2005). The direct impacts of trypanosomosis in production potential are seen in term of losses in milk, meat production, mortality and morbidity (PAAT, 2003) and the indirect losses include livestock and animal power exclusion from the hugest fertile infested lands(Bekele & Nasir,2011).

Bovine Trypanosomosis is a protozoan disease that is caused by *trypanosome spp* and transmitted by bites from tsetse flies (*Glossina spp*) (Alemayehu *et al.*, 2012). *Trypanosoma brucei, T.congolense*, and *T.vivax* are the infective agents for bovine trypanosomosis (Magona *et al.*, 2003). An infection with trypanosomes in cattle is responsible for peaks of hyperthermia, anaemia, severe loss in meat and milk production, decrease in fertility and increasing calf mortality (Zubairu *et al.*, 2013, Wanga & Munga, 2011).The tsetse –vectored disease is widely spread about 10 million Km^2 of fertile land across 37 countries in Africa as a continent in which Uganda is included (Oluwafemi *et al.*, 2007).

The livestock is observed to be the reservoir of the human trypanosomosis and poses a serious threat to human lives and livelihood. Up to 18% of the domestic animals in emerging sleeping sickness area are seen to be the reservoir of the disease (Magona & walubengo., 2011) and constitutes a greatest constraint to livestock production and responsible for under utilisation of natural resources in Africa (Mbahin *et al.*,2013).

The tsetse flies mostly infest the woodland and savannah areas which are a good potential grazing area for both wild and domestic animals (Fentahun & Tekeba, 2013). Some animals of wildlife species are trypanotolerant to the disease, which means the animals are resistant with trypanosomes infection as it was studied by (Swai & Kaaya ,2012). An entomology subsector

REFERENCES

1. Achukwi M.D. and Musongong G.A, (2009). Trypanosomosis in the Doayo/Namchi (Bos taurus) and zebu White Fulani (Bos indicus) cattle in Faro Division, North Cameroon. Journal of Applied Biosciences.Vol 15:807-814. Available on line www.biosciences.elewa.org
2. Adale. E and Yasine .A (2013). Prevalence of bovine trypanosomosis in Wolaita zone Kindo Koish district of Ethiopia. African Journal of Agricultural Research vol. 8(49), pp.6383-6387, 19 December, 2013. DOI; 10.5897/AJAR2013.7156. ISSN 1991-637X©2013 academic journals. Available at http://www.academicjournals.org/AJAR
3. Adama S (2013). Trypanosomosis Risk factors and impact assessment of a tsetse and trypanosomiasis eradication campaign in Burkina Faso) thesis submitted to the faculty of veterinary medicine, Ghent university support from PATTEC, Burkina Faso.
4. Alemayehu B, Basaznew B, Tewodros Fentahun, Mersha Chanie (2012).Bovine trypanosomosis; a threat to cattle production in Chena district, South west Ethiopia. Open Journal of Animal Sciences. vol.2, No.4, 287-291 (2012).doi;10.4236/ojas.2012.24039.
5. Anand S, Mandal T.K, and Sinha S (2013). Effect of does on disposition kinetics of isometamidium chloride/hydrochloride in trypanosomiasis induced calves. African journal of pharmacy and pharmacology. Vol.7 (15), pp. 801-808, 22 April, 2013. DOI 10.5897/AJPP2013.3521. ISSN 1996-0816. Available on http://www.academicjournals.org/AJPP
6. Ayele T, Epharem D., Elias K., Tamiru B., Gizaw D., Mebrahtu G.,Mebrat E (2012). Prevalence of bovine Trypanosomosis and its vector density in Daramallo district, south western Ethiopia. J Vet Adv 2012, 2(6): 266-272, ISSN: 2251-7685
7. Baticados W.N, Fernandez C.P, and Beticados A.M (2011). Molecular detection of *Trypanosoma evansi* in cattle from Quirino province, Philippines. *VETERINARSKI ARHIVE* 81(5), 635-646, 2011
8. Begna F, Abebe S. and Bekele M (2011). Bovine Trypanosomosis in Selected Villages of Humbo District, Southern Ethiopia.Global Veterinaria 7 (2): 192-198, 2011. ISSN 1992-6197 © IDOSI Publications, 2011

9. Bekele D., Moti Y., Hailu D., and Mezene W (2013). Cross sectional study of bovine trypanosomiasis and major clinical signs observed in Diga district, western Ethiopia. African journal of agricultural Research vol. 8(6), pp. 500-506, 25 february , 2013. DOI; 10.5897/AJAR12.1808. ISSN 1991-637X©2013 academic journals. Available on line at http://www.academicjournals.org/AJAR
10. Bekele M and Nasir M (2011). Prevalence and host related risk factors of bovine trypanosomosis in Hawagelan district, West Wellega zone, Western Ethiopia.African Journal of Agricultural Research Vol. 6(22), pp.5055-5060, 12 October, 2011. ISSN 1991-637X ©2011 Academic Journals.DOI: 10.5897/AJAR11.462. Available on line at http://www.academicjournals.org/AJAR
11. Biryomumaisho S,Rwakisyaya E.K (2012). The pathogenesis of Anaemia in African animal Trypanosomiasis , Anemia, Dr.Donald Silverberg(Ed),ISBN; 978-953-51-0138-3 available on line http://www.intechopen.com/books/anemia/the.pathogenesis.of.anaemia.in.african.animal.trypanosomosis
12. Dagnachew S., Girma H., and Abebe Getachew(2011). A cross sectional study on bovine trypanosomosis in JAwi district of Amhara Region, Northwest Ehiopia. Etiop. vet.j., 2011,15(1), 69-76.
13. Dagnatchew Z (1982). Trypanosomiasis in Ethiopia. Proceedings of the 3rd international symposium on veterinary epidemiology and economics, 1982 pg 467-473. Available at http://www.sciquest.org.nz
14. Despommier,Gwadz, hotez, Knirsch, Parasitic diseases, page 32-38 , apple trees production L.L C. NY. Or visit www.parasiticdiseases.org
15. Desta M,Desta B, Haile S (2013) Trypanosome infection rate of *Glossina pallidipes* and trypanosomiasis prevalence in cattle in Amaro special district of southern Ethiopia. Journal of veterinary medicine and animal health. Vol 5(6), pp.164-170, june 2013. DOI 10.5897/ JVMAH 2013.0199. available at http://www.academicjournals.org/JVMAH
16. DVO report (2013). Sub sector report to the district production officer. Un published (office copy).
17. Echodu R, sistrom M, Hyseni Chaz, Enyaru J, Okedi L, Aksoy S, and Caccone A (2013). Genetically Distinct *Glossina fuscipes fuscipes* population in the Lake Kyoga region of

Uganda and its relevance for Human African trypanosomiasis. Biomedical research international. Volume 2013, article ID 614721,12 pages http://www.hindawi.com

18. Efrem. D.B., Yacob.H T., Hagos A T. and Basu. A K. (2010). Bovine trypanosomosis in Gimbi district of Western Oromia, Ethiopia. Animal Biology 60 (2010) 123–131. DOI 10.1163/157075610X491653
19. Ekou J, (2013). Eradicating extreme poverty among rural poor in Uganda through poultry and cattle improvement programmes. Journal of development and agricultural economics.vol.5 (11), pp. 444-449.November, 2013. ISSN 2006-9774. Available on web
20. Eyobo E and Matios L (2013). Review on camel trypanosomosis (surra) due to *Trypanosoma evansi*: Epidemiology and host response. Journal of veterinary medicine and animal health.Vol.5 (12),pp.334-343,December,2013. DOI:10.5897/JVMAH2013.0236 http://www.academicjournals.org/JVMAH
21. Ezebuiro O.G.C, Abenga J.N, and Ekejindu G.O.C. (2009) the prevalence of trypanosome infection in trade cattle, Goats, and sheep slaughtered at the Kaduna Abattoir.african journal of clinical and experimental microbiology ,January 2009 ISBN 1595-689X VOL 10(1): AJCEM/200897/20904. http://www.ajol.info/journals/ajcem
22. FAO (1998). A field guide for the diagnosis, treatment and prevention of African animal trypanosomiasis. Chapter 1 pg 1-7, printed version. ISBN 92-5-104238-1.FAO Rome Italy.
23. FAO.(2005) Food comes First; FAO and the Eight Millennium development Goals,Rome;FAO,2010,BA call Number;3638091724 F6861 (F2--FAO) or http://www.fao.org/mdg/en
24. Fasanmi O.G, Okoroafor U.P, Nwufoh O.C, Bukola-Oladele O.M & Ajibola E.S (2014). Survey for trypanosoma species in cattle from three farms in Iddo Local Government Area, Oyo State. Sokoto journal of veterinary science (2014)12(1): 57-61. (p-ISSN 1595-093X/E-ISSN 2315-6201) available at http://dx.doi.org/10.4314/sokjvs.v12i1.9
25. Fentahun T and Tekeba M (2013). Prevalence of bovine Trypanosomosis and Distribution of vectors in Hawa Gelan District, Oromia Region, Ethiopia. Journal of veterinary Advances, J.vet.adv., 2013,3(8): 238-244. DOI: 10.5455/jva.20130331025023. http://www.grjournals.com

26. Fikru R, Hagos A, Roge´ S, Reyna-Bello A, Gonzatti MI, Merga B, Goddeeris BM, Buscher P (2014) A Proline Racemase Based PCR for Identification of Trypanosoma vivax in Cattle Blood. PLoS ONE 9(1): e84819. doi:10.1371/journal.pone.0084819. Available on line at www.plosone.org
27. Gutierrez F.R.S, Truijillo Guiza M.L, Escobar Martinez M.d.c (2013). Prevalence of trypanosoma cruiz infection among people aged 15 to 89 years inhabiting the department of Casanare (Colombia). PLoS Negl Trop Dis 7(3) e2113. Doi: 10.1371/journal.pntd.0002113.
28. Hendrickx G, Napala A, Dao B, Batawui K, Bastiaensen R, Deken D, vermeilen A, Vercruysse J, slingenbergh J.H.W (1999). The area-wide epidemiology of bovine trypanosomosis and its impact on mixed farming in sub humid West Africa; case study Togo. Veterinary Parasitology 84(1999) 13-31, Elsevier publication Pll; s0304-4017(99)00086-2.
29. Jing Z., Magona J.W., Sakurai .T, Thekisoe .O.M. M., Otim C.P, Sugimoto .C and Inoue.N (2008). A Field study to Estimate the Prevalence of Bovine African Trypanosomosis in Butaleja District, Uganda. J. Vet. Med. Sci. 71(4): 525–527, 2009
30. Kamyingkird K (2009). Thesis on Epidemiology of Trypanosoma evansi infection of Dairy cattle in Thailand, Master of Science (veterinary parasitology) graduate school Kasetsart University.
31. Karshima N.S, Ajogi I, Lawal A. I, Mohammed G and Okubanjo O. O (2012). Detection of *Trypanosoma Brucei Gambiense* specific Li Tat 1.3 Antibodies in Humans and Cattle in Taraba state, North Eastern Nigeria. Journal of veterinary Advances. J vet Adv 2012, 2(12): 580-585. ISSN 2251-7685. Available on line http://www.grjournals.com
32. Katiti D., Alibu V.P.and Matovu E (2013). Prevalence of animal trypanosomosis and corresponding immune responses in naturally infected cattle in Gulu district. (Makerere university library) and available also on line at http://www.au-ibar.org/../1732
33. Kitgum District Local Government (KDLG) (2012). Five Year Development Plan : policy issues FY 2010/11-2014/15 volume 1 available at www.kitgum.go.ug
34. Magona J.W. and Walubengo. J (2011). Mass-treatment and insecticide-spraying of animal reservoirs for emergency control of *Rhodesiense* sleeping sickness in Uganda. J Vector borne Dis 48, June 2011,pp 105-108.

35. Magona, J.W., Mayende, J.S.P., Olaho-Mukani, W., Coleman P.G Jonsson, N.N., Welburn, S.C. & Eisler, M.C. 2003. A comparative study on the clinical, parasitological and molecular diagnosis of bovine trypanosomosis In Uganda. Onderstepoort Journal/ of Veterinary Research. 70:213-218
36. Malele I,Nyingilili H and Msangi A (2011). Factors defining the distribution limit of tsetse infestation and the implication for livestock sector in Tanzania. African journal of agricultural research vol 6(10), pp. 2341-2347, 18 may, 2011.ISSN 1991-637x. Available online at http://www.academicjournals.org/AJAR
37. Mbahin J, Affognon H, Andoke J, Tiberius M, Mbuvi D, Otieno J, Muasa P, Saini R.K.(2013).Parasitological prevalence of bovine trypanosomosis in Kubo division of Kwale county of coastal: Base line Survey. American journal of animal and veterinary sciences, 8(1): 28-36,2013 ISSN: 1557-4555 or http://www.thescipub.com/ajavs.toc
38. Melaku A, Abebe A (2012) Bovine trypanosomiasis and its vector type and Density at Debre Elias District, North- Western, Ethiopia. Journal of Advance veterinary Research Vol 2 (2012) 2470251
39. Ministry of livestock development Kenya (2011) Strategy for Tsetse and trypanosomiasis Eradication in Kenya 2011-2021.
40. Mulumbu M.J (2006). The importance of *trypanosoma congolense* Strain diversity in the epidemiology of Bovine trypanosomiasis. PHD thesis. University of Gent, institute of tropical medicine Antwerp
41. Nonga H.E & Kambarage D.M. (2009). Prevalence of bovine trypanosomiasis in Morogoro, Tanzania. Pakistan journal of nutrition 8(3): 208-213,2009 ISSN 1680-5194
42. Nurulaini R, Premaalatha B, Zaini C.M, Adnan M, Chandrawathani P, Fazly ann Z.A, and Enie Aryanti A and Ramlan M(2013). Trypanosomiasis outbreak in Deer, cattle, bufalloes and pigs in Perak. Malaysian journal of veterinary Research. Vol No 1 january 2013. Page 55- 58.
43. Nyakowa.S.A, 2013. Use of cELISA in verification of drug levels in the serum following treatment by various personnel in Lamu District. Research Journal of Agriculture and Environmental Management. Vol. 3(2), pp. 106-136, February, 2013
44. Ocaido M, Otim C.P, Okuna N.M, Erume J, Ssekitto C, Wafula R.Z.O, kakaire D, Walubengo J, and Monard J. Socio-economic and livestock disease survey of agro-

pastoral communities in serere County, Soroti District,Uganda. Livestock research for rural development 17(8)2005.

45. OIE terrestrial manual (2013). Trypanosomosis (tsetse-transmitted) chapter 2.4.18
46. OIE Terrestrial Manual (2013.). Trypanosomiasis. Chapter 2.4.18 available at http://www.oie.int/en/our-scientific-expertise/reference-laboratories/list-of-laboratories/http://www.oie.int/
47. Okoth J.O.(1999) tstse and trypanosomiasis control problems in south- East Uganda:Past, present and alternative strategies. Congress report schweiz Med wochenschr 1999; 129:1091-8.
48. Oluwafemi R.A, Ilemobade A.A, and Laseinde, E.A.O. The impact of African Animal trypanosomiasis and tsetse on the livelihood and well-being of cattle and their owners in the BICOT study area of Nigeria. Academic Journals of scientific research and easy Vol.2 (9).PP. 380-383, (ISSN) 1992-2248 ©2007 Academic Journals. Or http://www.academicjournals.org/SRE
49. Otim C.P. Ocaido M, Okuna.N.M ,erume J. Ssekitto C,Wafula RZO, Kakaire D,Walubengo J, OkelloA, MugishaA and Mourad J.(2004).disease and vector constraints affecting cattle production in pastoral communities of Ssembabule District,Uganda. Livestock research for rural development 16(5) 2004.
50. PAAT (2003).Socio-economic and cultural factors in the research and control of trypanosomiasis. Chapter, page 1-page2 PAAT technical and scientific series 4 ISSN 1020-7163.A PAAT information Publication, Food and Agricultural Organisation of the United Nations Rome. Italy.
51. PAAT (2005). Trypanotolerant livestock in the context of trypanosomiasis intervention strategies. Chapter 2 Pg 6and 7. .PAAT technical and scientific series No.7, ISBN 92-5-105262-X. Rome. Italy.
52. Pace.J.E and Wakeman D.L. Determining the age of cattle by their teeth. University of Florida IFAS Extension. CIR253. Available on web http://edis.ifas.ufl.edu.
53. PATTEC (2008), African trypanosomiasis, strategic plan for advocacy phase 1; 2008-2011.PATTEC coordination , commission of the African union Addis Ababa, Ethiopia Available online at http://www.africa-union.org

54. Radostits. O M., Clive G. C. Kenneth W.H, Constable P.D (2006). Veterinary Medicine, a textbook of the diseases of cattle, sheep, goats, pigs, and horses. Chapter 26 part 2 pg 1531-pg 1540.10th edition.ISBN:978-0-7020-2777-2.ELSEVIER publication Edinburgh London New York oxford Philadelphia St Louis Sydney Toronto.
55. Radwan.M.E.I , El Madawy R(2010). Diagnosis and epidemiological studies of bovine trypanosomiasis in Kaliobia Governorate. Journal of American science 2010; 6(11): 894-898]. (ISSN: 1545-1003).
56. Rahman A.H, Ibtisam A.G. Rihab A.Y, Salima A.R and Gasmir G.S (2008). The effect of Bovine Trypanosomiasis and endo-parasitism on milk production of a dairy farm in white nile states, Sudan. The Sudan J.Vet.Res.(2008), 23;19-27.
57. Rutto J.J, Osano O, Thuranira E.G, Kurgat R.K, odenyo V.A.O (2013) socio-economic and cultural Determinants of Human African Trypanosomiasis at the Kenya –uganda Transboundary PLOS Negl.Trop Dis7(4)e2186. Doi: 10.1371/journal.pntd.0002186.
58. Salim.B, Bakheit A.M, Salih S.E, Kamau J, Nakamura I, Nakao R, Sugimoto C (2011).An outbreak of bovine trypanosomiasis in the Blue Nile State, Sudan, parasites and vectors 2011,4;74 0r Http://www.parasitesandvectors.com/content/4/1/74
59. Selby. R (2010). Limiting the northerly advance of *Trypanosoma brucei rhodesiense* in post conflict Uganda. The University of Edinburgh. PHD thesis.
60. Singla L.D, Sharma A, Kaur P, Tuli A, Bhat SA, and Bal S M (2013). Bovine Trypanosomosis in Punjab: Assessment of seroprevalence by CATT/ *T. evansi.* International Journal of Advanced Research .Volume 1, Issue 9, 364-371. ISSN 2320-5407.
61. Sow A.(2013). Trypanosomosis risk factors and impact assessment of a tstse and trypanosomosis eradication campaign in Burkina Faso . PATTEC (PhD thesis). Universiteit Gent.
62. Stevrding. D (2008). The history of African trypanosomiasis. Parasites & Vectors. Address: BioMedical Research Centre, School of Medicine, Health Policy and Practice, University of East Anglia, Norwich NR4 7TJ, UK. Parasites & Vectors 2008, **1**:3 doi: 10.1186/1756-3305-1-3. Available at; http://www.parasitesandvectors.com/content/1/1/3
63. Steyn H C, McCrindle C M E, Du Toit D (2010). Veterinary extension on sampling techniques related to heart water research. Journal of the South African Veterinary

Association 81(3):160–165 (En.). Onderstepoort Veterinary Institute, Private Bag X5, Onderstepoort, 0110 South Africa

64. Swai E.S, Kaaya J.E (2012). A parasitiological survey for bovine trypanosomosis in the livestock / wildlife ecozone of northern Tanzania, vetworld 5(8): 459-464. Doi: 10.5455/vetworld.2012.459-464 or http://veterinaryworld.org
65. Teka W, Terefe D, Wondimu A (2012). Prevalence study of bovine Trypanosomiasis and Tsetse density in Selected Villages of Arbaminch, Ethiopia. Journal of veterinary Medicine and Animal Health vol. 4(3),pp.36-41, april 2012 available on line at http://www.academicjournals.org/JVMAH
66. The centre for food security and public health (CFSPH) (2009.). African animal Trypanosomiasis .Iowa State University, college of veterinary medicine Iowa State university available on http://www.cfsph.iastate.edu
67. Thrushfield, M (2005). Veterinary epidemiology. 2nd Edition, Blackwell science, Oxford 117-198.
68. Thumbi.S.M, Jung'a O.J, Mosi .R.O, McOdimba F.A (2010) spatial distribution of African animal trypanosomiasis in Suba and Teso districts in western Kenya. BMC research notes 2010, 3:6.http://www.biomedcentral.com/1756-0500/3/6
69. Uganda bureau of statistics (UBOS)(2013).Statistical abstract
70. Van den Bossche P.general (2001).Some general aspects of the distribution and epidemiology of bovine trypanosomiasis in southern Africa. International journal for Parasitology 31(2001) 592-598. Elsevier publication. Or http://www.parasitology-online.com
71. Waiswa, C (2010). Domestic pigs as reservoirs for the zoonotic *trypanosome brucei rhodesiense* sleeping sickness in Uganda. Africa journal of Animal and biomedical sciences 5(2), 2010. ISSN: 1819-4214
72. Wanga C.H and Munga Leonard (2011).The effective eradication and control strategies for tsetse and trypanosomiasis the Kenya experience. Journal of commonwealth veterinary association special issues .July 2011, vol27 No.2 5th Pan Commonwealth veterinary conference 21-25 March 2011, Accra, Ghana. ISBN 978-92-79-19912-7 or http://ec.europa.eu/food/animals/welfare/index_en.htm

73. Welburn S,Picozzi K, Coleman G.P,Packer C (2008).Patterns in age-seroprevalence consistent with acquired immunity against trypanosoma brucei in Serengeti Lions PLoS Negl Trop Dis 2(12);e347.doi:10.1371/journal.pntd.0000347

74. Wobo S.O.S, Igenezoa A.J, Idowu O.A, Otesile E.B, Ekpo U.F and Kehinde O.O (2010). Bovine trypanosomiasis and its impact on cattle in derived Savanna areas of Ogun State, Nigeria. Journal of public health and epidemiology Vol 1(3), pp. 43-47, june 2010. ISSN 2141- 2316 available online at http://www.academicjournals.org/jphe

75. Zubairu A.I, Midau A, Dazala I.U, Yaha M.M, Buba Z.M.(2013)The prevalence of Bovine Trypanosomiasis in Song Local Government Area of Adamawa State, Nigeria.Global veterinarian 11(3)310-313,2013,(ISSN) 1992-6197, © IDOSI Publications,2013.DOI;10.582/idosi.gv.2013.11.3.7547.