Uganda Journal of Agricultural Sciences, 2012, 13 (2): 107-116 ISSN 1026-0919
Printed in Uganda. All rights reserved © 2012, National Agricultural Research Organisation

Knowledge and perceptions of smallholder dairy farmers of cattle disease burdens in selected agro-ecological zones of Uganda

H. Kirunda[1], F. Kabi[1], N. Muwereza[1], T. Kabuuka[1], J.W. Magona[2] and G. Lukwago[3]

[1]National Livestock Resources Research Institute (NaLIRRI), P. O. Box 96, Tororo, Uganda
[2]Bulindi Zonal Agricultural Research and Development Institute, (BuZARDI), P. O. Box 101, Hoima, Uganda
[3]National Agricultural Research Organization (NARO). P. O. Box 295, Entebbe, Uganda

Author for correspondence: halidkirunda@gmail.com

Abstract

Diseases have continued to affect production and productivity in smallholder dairy farming systems in Uganda. This study sought to establish farmers' knowledge and perceptions of disease burden in the Eastern Semi-Arid Zone (ESAZ), Lake Victoria Basin (LVB) and Western Rangelands (WR) agro-ecological zones (AEZs). A structured questionnaire was administered to 150 farm household heads or cattle attendants. Data analysis by cross tabulations was done using SPSS Statistical Software and descriptive statistics generated in XLSTAT. Linear Discriminant analysis and Multivariate Analysis of Variance were computed to establish significant relationships ($P<0.05$) between variables. East Coast fever (ECF), calf scours, foot rot, mastitis and fascioliasis were reported of high prevalence (≥50%), while bruceliosis and eye infection had low prevalence (≤16.7%). Season, age and breed of cattle were significantly associated with severity, morbidity, mortality and treatment costs in all AEZs. Morbidity and mortality were higher during the long (4.5; 0.7) than short rains (3.1; 0.6), respectively. Comparatively, average treatment costs were higher during the short rains (US$ 22) compared to long rains (US$ 17) each rains lasting three months. Results of our study show that some diseases were common to all AEZs, yet ESAZ had a higher disease burden than WR and LVB.

Key words: Cross-bred cattle, dairy cattle, diseases, exotic breeds, indigenous breeds

Introduction

Uganda has a cattle population of 11.4 million (UBOS/MAAIF, 2009), of which the indigenous cattle accounts for 82.7% that is owned by 96% of subsistence small-scale farmers (Okidi *et al.*, 2004). Dairy production contributes 45% of the 9% that the livestock sector adds to the national gross domestic product (UBOS, 2007).The other proportion (17.3%) of the total dairy herd is comprised of crossbred and pure exotic cattle (UBOS, 2009). Dairy production and productivity have remained low partly due to disease infections in livestock (NDP, 2010). Wozemba and Nsanja (2008) estimated losses due to animal diseases to be as high as US$ 86.3 million per year and are mainly as a result of high morbidity (58%) and mortality (30%). Tick-borne infections are known to exert the greatest limitations to improved cattle production by causing serious debility, morbidity, mortality and

production losses in susceptible exotic cattle, their crosses and indigenous breeds raised in tick-borne disease free areas (Okello-Onen *et al.*, 1994; Perry and Randolph, 1999). Tick borne diseases are still widely prevalent in Uganda (Rubaire-Akiiki *et al.*, 2004, Ochaido *et al.*, 2009b) with the highest severity among exotic cattle. Among the other key diseases affecting dairy production in Uganda are Trypanosomiasis (Waiswa and Katunguka, 2004), Mastitis (Byarugaba *et al.*, 2008) and brucellosis (Makita *et al.*, 2011). In a study by Ocaido *et al.* (2009a) farmers' perceptions ranked East Coast Fever (ECF) at 73.8% - 85.0% level of prevalence, while variation was observed in the level of Foot and Mouth Disease (FMD), Trypanosomosis, Lumpy skin disease (LSD), Helminthosis and Anaplasmosis among diseases in districts of different agro-ecological zones. Many other challenges including calf mortality have recently been reported (Ocaido *et al.*, 2009b). This study sought to establish the disease burden in smallholder dairy farming systems as perceived by farmers as to guide control based on AEZs in Uganda.

Materials and methods

Study area

The survey was conducted in purposively selected districts of Jinja, Kiruhura and Katakwi, each representing a specific AEZ including Lake Victoria Basin (LVB), Western Rangelands (WR) and the Eastern Semi Arid Zone (ESAZ) (Mwebaze, 1999), respectively.

Study design and data collection

The district production department in each district provided a sampling frame of all livestock keeping households. Using the sampling frame, 50 households were selected from each study district following systematic random sampling procedures. The total number of livestock keeping households in each district was divided by 50 to obtain an n^{th} value. The first household was chosen randomly and subsequent households were chosen at an interval until 50 households were selected. The study questionnaire was administered to a total of 150 farming households during which farmers' perceptions on animal health parameters were captured. Based on farmer's perception, diseases were ranked based on reported level of severity using a scale of 1 to 3, with 1 signifying high severity, 2 moderate severity and 3 low severity. The mean severity of 2 was obtained. Similarly, a scale of 1 to 7 was used to measure the degree of perceived morbidity due to a particular disease. On this scale, average of 1 to 2 signified lowest, 3 to 5 was moderate and 6 to 7 represented the highest level of morbidity. The mean morbidity of 3 was considered moderate for a given disease. All diseases with average severity of d" 2 and e" 3.0 were taken as the most important diseases in the AEZ. Field veterinary staff interpreted the disease names and clinical signs to the respondents in indigenous language in each study district.

Validity of the questionnaire data

In order to validate the content of data generated using the questionnaire, the content validity ratio (CVR) as described by Lawshe (1975) was used. The mean CVR across items was used as an indicator of overall test content validity.

Data processing and analysis

Data analysis, cross tabulation and graphic drawings were done using SPSS. XLSTAT (2011) was used to generate descriptive

statistics for all variables. Linear Discriminant analysis (Huberty, 1994) in XLSTAT 2011 Statistical Software was conducted based on the assumption that within-class covariance matrices were equal. Discriminant analysis was used to establish a set of linear combinations of the quantitative variables that best revealed significant differences among AEZs with regard to common livestock diseases and test for existence of significant effects ($p<0.05$) of season, age of animal and breed on perceived disease severity, morbidity, prevalence, mortality and treatment costs. To establish the influence of AEZs on disease, Multivariate Analysis of Variance was conducted using the PAST software and means separated using the Wilk's lambda test p-values. Scatter plots were drawn and biplots fitted to show the correlations.

Results

Reproduction problems among cattle of different breeds

Calf survival varied among the different cattle breeds kept in the different AEZs. While cross-bred cattle were reported to have 100% calf survival, proportions were lower among indigenous (54.8%) and exotic cattle (47.1%) in the ESAZ (Table 1). In the LVB, calf survival was >90.0% for both crosses and exotic cattle and lower for indigenous cattle (71.4%). With exception of ESAZ and LVB, farmers reported a calf survival (89.2%) among indigenous cattle compared to cross-bred (82.3%) and exotic cattle (77.3%). Overall, crosses had higher calf survival compared to indigenous and exotic breeds. No cases of abortion were reported in LVB, though the condition was reportedly

Table 1. Proportions of reproduction conditions in different cattle breeds

Reproduction problems	AEZs	Exotic	Cross	Indigenous
Calf survival (%)	ESAZ	47.1	100	54.8
	LVB	90.9	95.8	71.4
	WR	77.3	82.3	89.2
	Overall	73.8	82.9	73.0
Abortions (% out of total served)	ESAZ	20	0	3.7
	LVB	0	0	0
	WR	9.1	3.5	1.4
	Overall	9.3	3.4	2.1
Still births (% out of total served)	ESAZ	0	0	0.9
	LVB	0	0	0
	WR	30.1	1.4	9.5
	Overall	26	1.35	6.61
Calves born with deformities (%)	ESAZ	0	0	0.9
	LVB	0	0	0
	WR	1.7	1.0	0
	Overall	1.5	0.94	0.3

low among herds in the WR. In WR, proportions of still births and calves born with deformities were high, yet no reports of stillbirths were recorded in LVB. The prevalence of still births in the WR was 30.1% among exotic cattle, 9.5% in indigenous and 1.4% for cross-breeds. As shown in Table 1, pneumonia and dystocia were perceived as the major causes of calf death in exotic breeds accounting for 28.6% and 21.4% of calf mortality, respectively. In crosses, calf death was mainly attributed to tick borne diseases (TBDs) (37.5%), followed by diarrhoea (33.3%) and pneumonia (16.7%). Tick borne diseases were perceived to cause 52.9% of calf mortality among indigenous cattle, while dystocia and pneumonia reportedly caused 11.8% mortality. In a descending order of importance, calf mortality was attributed to TBDs (35%), pneumonia (20%), diarrhoea (15.5%) and dystocia (12.5%).

Prevalence of cattle diseases

In this study, it was observed that calf scours, fascioliasis, foot rot and mastitis occurred in all zones, but with levels of prevalence ranging from 14.3% to 100% (Table 2). Other diseases perceived by farmers as important were babesiosis, FMD, abortions, calf pneumonia and retained foetal membranes (RFM). The prevalence of most of the diseases was generally higher in ESAZ compared to WR and LVB. Brucellosis was only reported in the ESAZ, while anaplasmosis only occurred in the WR. Conditions restricted to LVB were milk fever, eye infection and PGE. Prevalence of abortion

Table 2. Percent seasonal prevalence of diseases in the three agro-ecological zone

Disease/condition	ESAZ		WR		LVB	
	Long rains	Short rains	Long rains	Short rains	Long rains	Short rains
Abortion	57.1	42.9	100.0	0.0	-	-
Anaplasmosis	-	-	90.0	10.0	-	-
Babesiosis	33.3	66.7	71.4	28.6	-	-
Brucellosis	40.0	60.0	-	-	-	-
Calf pneumonia	100.0	0.0	100.0	0.0	-	-
Calf scours	85.7	14.3	100.0	0.0	100.0	0.0
CBPP[a]	-	-	25.0	75.0	-	-
ECF[b]	75.0	25.0	41.7	58.3	100.0	0.0
Eye infection	-	-	-	-	0.0	100.0
FMD[c]	100.0	0.0	60.0	40.0	-	-
Foot rot	100.0	0.0	66.7	33.3	100.0	0.0
Fascioliasis	75.0	25.0	66.7	33.3	100.0	0.0
Mastitis	53.3	46.7	63.2	36.8	100.0	0.0
Milk fever	-	-	-	-	0.0	100.0
PGE[d]	-	-	-	-	100.0	0.0
RFM[e]	100.0	0.0	-	-	100.0	0.0

[a]CBPP (Contageous Bovine Pleuropneumonia); [b]ECF (East Coast Fever); [c]FMD (Foot and Mouth Disease); [d]PGE (Parasitic Gastroenteritis); [e]RFM (Retained Foetal Membranes)

and mastitis were significantly (P<0.05) higher in the ESAZ (18%; 34%) compared to WR (12%; 24%) and LVB (7%; 10%), respectively, while milk fever was higher in the LVB (18%) in comparison with ESAZ (6%) and WR (5%).

Disease severity in AEZs

East Coast Fever was reported as a severe disease in all AEZs, while calf pneumonia, abortion, anaplasmosis and babesiosis occurred with high severity in WR (Table 3). Other diseases were perceived to occur but only with moderate severity.

Disease severity and prevalence in different seasons

Season significantly (P<0.05) influenced the severity, morbidity, mortality and treatment costs. Severity was reportedly similar in both short and long rains (1.6), but morbidity was higher in long (4.5) than short rain season (3.1). Mortality was higher in long (0.7) than short rains (0.6) and average costs of treatment were higher in short (US$ 22) than long rains (US$ 17). Each season of rains lasts three months.

Disease severity, mortality and average cost of treatment per AEZ

In the LVB, ECF and mastitis had the highest perceived morbidity (1.9; 3.7), severity (1.33; 1.33), mortalities (0.42; 0.33) and treatment costs (US$ 15; US$ 16) per a quarter of a year, respectively. In the ESAZ, fascioliasis, mastitis and abortion had the highest severity (2; 2; 2) and morbidity (16; 4.4; 5.5), respectively, while abortion caused the highest mortalities (1.0) and ECF had the highest treatment cost (US$ 18). Highest severities of 1.9; 1.8 and 1.5 and morbidity (4.0; 4.2; 3.2), respectively, were for mastitis, FMD and ECF in the WR. Whereas the highest mortalities (1.5; 1.2) were due to FMD and ECF, treatment costs were generally highest for ECF (US$ 26) and babesiosis (US$ 17) for each period of three months.

Table 3. Diseases with highest morbidity in each AEZ

ESAZ		WR		LVB	
Disease	Average severity	Disease	Average severity	Disease	Average severity
ECF[a]	1.5	ECF	1.5	ECF	1.3
Mastitis	2	Mastitis	1.7	Mastitis	1.7
Calf scour	2	Calf pneumonia	1	Calf Scour	2
FMD[b]	2	FMD	1.8	Liver fluke	1.5
Abortion	2	Abortion	1	Eye infection	2
Liver fluke	2	Anaplasmosis	1.3	Milk fever	2
				RFM[c]	1
				PGE[d]	1.5

[a]ECF (East Coast Fever); [b]FMD (Foot and Mouth Disease); [c]PGE (Parasitic Gastroenteritis); [d]RFM (Retained Foetal Membranes)

Disease severity, mortality and average cost of treatment for different cattle breeds

Disease severity, morbidity, mortality and treatment costs were significantly different ($p<0.05$) among the indigenous, exotic and crossbred cattle in the three AEZs. Severity was 1.9 in indigenous, 1.5 in exotics and 1.3 in crosses. Morbidity was highest in indigenous (5.5), followed by crosses (4.1) and least (2.3) in exotics. Comparatively, mortality was high in crosses (1.0), low in indigenous (0.7) and lowest in exotics (0.1). Yet, treatment costs were highest for crosses (US$ 25), followed by indigenous (US$ 17) and least in exotics (US$ 11).

Disease severity, mortality and average cost of treatment in different cattle age groups

Age of cattle had significant effect ($P<0.05$) on severity, morbidity, mortality and treatment costs in all AEZs. Severity was higher in mature cattle (1.6) as compared to infants (1.4), yet morbidity was higher in mature (4.5) than young cattle (3.2). In contrast, mortality was higher in young ones (1.0) than mature (0.6) and treatment costs were higher for young (US$ 19) compared to mature cattle (US$ 18).

Discussion

This study investigated farmers' knowledge and perceptions on different dairy cattle disease conditions at herd level. While the number of disease conditions and their severity, morbidity and prevalence as reported in this study may not be compared directly with results of laboratory-based studies, these results provide baseline information to guide future in-depth studies. Unlike a similar study, previously undertaken by Ocaido *et al.* (2009a), this study revealed a higher number and variation in disease occurrence in the smallholder dairy farming systems.

The average calf survival proportion observed in this study was below 90% previously reported among the indigenous Ankole breed in WR zone of Uganda (Kugonza*et al.*, 2011). Similarly, the result on crossbreeds was higher than 50% level of calf survival reported by Said *et al.* (2001) in Tanzania, but in similar range (71.2 - 90%) with results of a study by Diack *et al.* (2004) in Gambia. The 73.8% level of calf survival among exotic cattle was below 99% observed elsewhere (Bebe *et al.*, 2003). Equally, the prevalence of dystociashown in our study was lower than 5.6%in indigenous and crosses but higher than 9.3% reported among exotics (Gashaw *et al.*, 2011).

The result that ECF was an important disease in all study AEZs (Ocaido *et al.*, 2009a) was reproduced byour study. While some variations existed, the observation concurred with the findings by Rubaire-Akiiki *et al.* (2004), which showed that prevalence of TBDs in dairy cattle varies with AEZ and management system. These diseases (ECF, babesiosis and anaplasmosis) are endemic in Uganda (Rubaire-Akiiki *et al.*, 2004), just as FMD and CBPP (Ocaido *et al.*, 2009b; Tambi *et al.*, 2006).

The prevalence of abortion reported in this study (2.1 - 9.1%), is comparable to 8.7% reported of indigenous cattle elsewhere (Degefa *et al.*, 2011). However, prevalence (100%) of RFM was generally higher than 19.2% reported by Gashaw *et al.* (2011), 5-8% by Correa *et al.* (1990) and 7.1 - 28.9% by Tekelye *et al.* (1992).The fact that brucellosis was reported in the ESAZ, it was not

mentioned in the WR, contrary to those in earlier studies (Kabagambe *et al.*, 2001; Faye *et al.*, 2005). In ESAZ, herd prevalence (40.0 - 60.0%) was similar to that (55.6%) reported in a serological study in Southwestern Uganda (Faye *et al.*, 2005). Generally, herd prevalence of brucellosis in Uganda has been reported to be between 6.5 and13.0% (Kabagambe *et al.*, 2001; Makita *et al.*, 2011) and 5.1 - 18.6% in studies conducted elsewhere (Jergefa *et al.*, 2009).

High levels of morbidity, severity and mortalities due to mastitis reported of the LVB were generally not common signs for the disease. Exotic cattle in LVB are mainly kept in zero grazing units where the level of hygiene is usually poor (Byarugaba *et al.*, 2008) and this could easily predispose the udder to infection with bacteria. While high herd prevalence (100%)was recorded of milk fever, this condition is rare in Uganda and literature about the disease is generally lacking. On average, 5-10% of dairy cows succumb to clinical milk fever and herd prevalence of about 34 - 50%has been reported in other areas of the world (Houe *et al.*, 2001; Roche, 2003). High prevalence of milk fever in LVB could be due to high milk yielding cattle kept in some farm units in the zone. Such cattle may experience nutritional deficiencies of calcium and magnesium especially during the season of short rains since short rains have been associated with feed shortages and reduced nutritive value of feeds (Njoka-Njiru *et al.*, 2006).

The high severity of calf diseases (scours and pneumonia) reported in all AEZswas possibly due to poor hygienic conditions (Byarugaba *et al.*, 2008). While literature on the condition of calf scours and pneumonia in Uganda is not readily available, reports elsewhere show 5.1 - 21% prevalence of calf diarrhoea (Achá *et al.*, 2004). Similarly, literature on eye infection is lacking but 7.2% perceived prevalence of blindness in cattle has previously been reported in Uganda (Ocaido *et al.*, 2009a).

The high severity of fascioliasis in ESAZ and LVB is not surprising; fascioliasis causes significant morbidity and mortality in livestock (Okewole*et al.*, 2000). But 100% herd prevalence could be misleading. Previous farmer perceptions in Uganda (Ocaido *et al.*, 2009a) have indicated 63.8% prevalence of helmenthosisincluding PGE and similarly, 51.9 - 62.0% prevalence has been reported in related areas in Ethiopia (Asrat, 2004). Recently, the ESAZ has commonly experienced floods, yet communal grazing is a common practice in this zone. Waterlogging is a risk factor for liver fluke infestation (Lemma *et al.*,1985). However, the significance of fascioliasis in LVB is doubted since most herds in LVB are rarely grazed or watered from water logged areas.

Conclusion

Results of our study show that some diseases were common to all AEZs, yet ESAZ had a higher disease burden than WR and LVB. Similar findings were revealed in a study by Ocaido *et al.* (2009a).

Acknowledgement

Through the Eastern Africa Agricultural Productivity Project (EAAPP)/National Agricultural Research Organisation (NARO) and National Livestock Resources Research Institute (NaLIRRI), we thank the Government of Uganda for funding this work.

References

Achá, S.J., Kühn, I., Jonsson, P., Mbazima, G., Katouli, M.and Möllby, R. 2004. Studies on calf diarrhoea in Mozambique: Prevalence of bacterial pathogens, *Acta Veterinaria Scandinavica* 45:27-36. doi:10.1186/1751-0147-45-27.

Asrat, M. 2004. Infection prevalence of ovine fasciolosis in irrigation schemes along the upper Awåsh River Basin and effects of strategic anthelmintic treatment in selected upstream areas, An MSc Dissertation submitted to Addis Ababa University, Ethiopia.

Bebe, B.O., Udo, H.M.J, Rowlands, G.J. and Thorpe, W. 2003. Smallholder dairy systems in the Kenya highlands: cattle population dynamics under increasing intensification, *Livestock Production Science* 82:211-221.

Byarugaba, D.K., Nakavuma, J.L, Vaarst, M. and Laker, C. 2008. Mastitis occurrence and constraints to mastitis control in smallholder dairy farming systems in Uganda. *Livestock Research for Rural Development* 20, Article #5,Retrieved February 29, 2012, from http://www.lrrd.org/lrrd20/1/byar20005.htm.

Correa, M.T., Curtis, C.R., Erb, H.N., Screlett, J.M. and Smith, R.D. 1990. An ecological risk factor for postpartum disorders of holstein-friesian cows form thirty-two, New York farms. *Journal of Dairy Science* 73:1515-1524.

Degefa, T., Duressa, A.and Duguma, R. 2011. Brucellosis and some reproductive problems of indigenous Arsi cattle in selected Arsi zones of Oromia regional state, Ethiopia. *Global Veterinaria* 7(1):45-53.

Diack, A., Sanyang, F.B. and Corr, N., 2004. Survival, growth and reproductive performance in F1 crossbred cattle produced and managed on station in the Gambia. *Livestock Research for Rural Development* 21:155. Retrieved February 29, 2012, http://www.lrrd.org/lrrd21/9/ocai21155.htm.

Faye, B., Castel, V., Lesnoff, M., Rutabinda, D. and Dhalwa, S. 2005. Tuberculosis and brucellosis prevalence survey on dairy cattle in Mbarara milk basin (Uganda). *Preventive Veterinary Medicine* 67(4):267-281.

Gashaw, A., Worku, F. and Mulugeta, S., 2011. Assessment of smallholder dairy production systems and their reproductive health problems in Jimma Town, Southwestern Ethiopia. *International Journal of Applied Research in Veterinary Medicine* 9(1):80-86.

Houe, H., Ostergaard, S., Thilsing-Hansen, T., Jorgensen, R.J., Larsen, T., Sorensen, J.T., Agger, J.F. and Blom, J.Y. 2001. Milk fever and subclinical hypocalcaemia - an evaluation of parameters on incidence risk, diagnosis, risk factors and biological effects as input for a decision support system for disease control. *Acta Veterinaria Scandinavica* 42:1-29.

Huberty, C.J. 1994. Applied discriminant analysis (Wiley, New York).

Jergefa, T., Kelay, B., Bekana, M., Teshale, S., Gustafson, H. and Kindahl, H. 2009. Epidemiological study of bovine brucellosis in three agro-ecological areas of central Oromiya, Ethiopia, Scientific and Technical

Review. *World Organisation for Animal Health (OIE)* 28(3):933-943.

Kabagambe, E.K., Elzer, P.H., Geaghan, J.P., Opuda-Asibo, J., Scholl, D.T. and Miller, J.E. 2001. Risk factors for brucella seropositivity in goat herds in eastern and western Uganda. *Preventive Veterinary Medicine* 52: 91-108.

Kugonza, D.R., Nabasirye, M., Mpairwe, D., Hanotte, O. and Okeyo, A.M. 2011. Productivity and morphology of Ankole cattle in three livestock production systems in Uganda. *Animal Genetic Resources* 48:13-22 doi:10.1017/S2078633611000038.

Lawshe, C.H. 1975. A quantitative approach to content validity. *Personnel Psychology* 28(4):563-575.

Lemma, B., Gabreab, F. and Tedla, S. 1985. Studies on fasciolosis in four selected sites in Ethiopia. *Veterinary Parasitology* 18:29-37.

Makita, K., Fèvre, E.M., Waiswa, C., Eisler, M.C., Thrusfield, M. and Welburn, S.C. 2011. Herd prevalence of bovine brucellosis and analysis of risk factors in cattle in urban and peri-urban areas of the Kampala economic zone, Uganda. *BMC Veterinary Research*, 7(60):1-8, http://www.biomedcentral.com/1746-6148/7/60.

Mwebaze, S.M.N. 1999. Uganda country pasture and forage resources profiles. Suttie, J.M. and Reynlods, S.G. (eds.). Ministry of Agriculture, Animal Industry and Fisheries. http://www.fao.org/ag/AGP/AGPC/doc/counprof/Uganda/uganda.htm

NDP, 2010. National Development Plan (2010/11 - 2014/15); Growth, Employment and Socio-economic Transformation for Prosperity, April 2010.

Njoka-Njiru, E.N., Njarui, M.G., Abdulrazak, S.A. and Mureithi, J.G. 2006. Effect of intercropping herbaceous legumes with Napier grass on dry matter yield and nutritive value of the feedstuffs in semi-arid region of eastern Kenya. *Agricultura Tropica et Subtropica* 39:255-267.

Ocaido. M., Otim, C.P. and Kakaire, D. 2009a. Impact of major diseases and vectors in smallholder cattle production systems in different agro-ecological zones and farming systems in Uganda. *Livestock Research for Rural Development* 21:155. Retrieved February 29, 2012, http://www.lrrd.org/lrrd21/9/ocai21155.htm.

Ocaido, M., Muwazi, R. T. and Opuda-Asibo, J. 2009b. Disease incidence in ranch and pastoral livestock herds around Lake Mburo National Park, in South Western Uganda. *Tropical Animal Health and Production* 41(7):1299-1308. DOI: 10.1007/s11250-009-9315-x.

Okello-Onen, J., Tukahirwa, E.M., Ssenyonga, G.S.Z., Perry, B.D., Katende, J.M., Musisi, G. and Mwayi, M.T. 1994. Epidemiology of *Theileria parva* under ranch conditions in Uganda. In: Rowlands, G.J., Kyule, M.N. and Perry, B.D. (Eds.). Proceedings of the 7th International Symposium on Veterinary Epidemiology and Economics, Nairobi, Kenya, 15-19 August. *The Kenyan Veterinarian* (Special Issue) 18(2):362-365.

Okewole, E.A. Ogundipe, G.A.T. Adejinmi, J.O. and Olaniyan, A.O. 2000. Clinical evaluation of three chemo-prophylactic regimes against ovine helminthosis in a fasciola endemin farm in Ibadan, Nigeria.

Israel Journal of Veterinary Medicine 56(1):15-28.

Okidi, J.A., Ssewanyana, S., Bategeka, L. and Muhumuza, F. 2004. Operationalising pro-poor growth: A country case study on Uganda: AFD, BMZ, DFID, and the World Bank.

Perry, B.D. and Randolph, T.F. 1999. Improving the assessment of the economic impact of parasitic diseases and of their control in production animals. *Veterinary Parasitology* 84:145-168. doi:10.1016/S0304-4017(99) 00040-0

Roche, J.R. 2003. The incidence and control of hypocalcaemia in pasture-based systems, *Acta Veterinaria Scandinavica* Suppl 97:141-144.

Rubaire-Akiiki, C., Okello-Onen, J., Nasinyama, G., Vaarst, M., Kabagambe, E.K., Mwayi, W., Musunga, D. and Wandukwa, W. 2004. The prevalence of serum antibodies to tick-borne infections in Mbale District, Uganda: By agro-ecological zone, grazing management and age of cattle. *Journal of Insect Science* 4(8):1-12. insectscience.org/4.8

Said, R., Bryant, M.J. and Msechu, J.K.K. 2001. Growth and survival of crossbred beef cattle in Tanzania. *Tanzanian Society for Animal Production Proceedings* 28.

Tambi, N.E., Maina, W.O. and Ndi, C. 2006. An estimation of the economic impact of contagious bovine pleuropneumonia in Africa. Scientific and Technical Review. *World Organisation for Animal Health (OIE)* 25(3):999-1012.

Tekelye, B., Kasali, O.B. and Gashaw, T., 1992. Reproductive problems in indigenous cattle of the Ministry of Agriculture-farms in central Ethiopia. *Tropical Agriculture* (Trinidad) 69: 247-249.

UBOS (Uganda Bureau of Statistics), 2007. Uganda National Housing Survey Report 2005/06. Uganda Bureau of Statistics, Kampala. http://www. ubos.org

UBOS/MAAIF (Uganda Bureau of Statistics/Ministry of Agriculture, Animal Industry and Fisheries), 2009. Livestock Numbers. 2008, *National Data Base*, http://www. ubos.org

Waiswa,C. and Katunguka-Rwakishaya, E. 2004. Bovine trypanosomiasis in south-western Uganda: packed-cell volumes and prevalences of infection in the cattle. *Annals of Tropical Medicine and Parasitology* 98(1):21-27.

Wozemba, D. and Nsanja, R. 2008. Dairy Investment Opportunities in Uganda Report: *Dairy Sector Analysis*, SNV 2008.