www.roavs.com EISSN: 2223-0343

RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Participatory risk assessment of Peste des petit ruminants: Factor analysis of small ruminants' pastoral management practices in Turkana district, Kenya

Kihu S. M.[1,3*], Gitao C. G.[1], Bebora L. C.[1], Njenga M. J.[1], Wairire G. G.[2], Maingi N.[1] and Wahome R. G.[1]

[1]Faculty of veterinary medicine, University of Nairobi, P.O. Box 29053-00625 Uthiru, Kenya;
[2]Faculty of Art, University of Nairobi, P.O. Bo x 30197- 00100 Nairobi, Kenya;
[3]Vetworks Eastern Africa, P.O. Box 10431- 00200 Nairobi, Kenya

Abstract

Peste des petit ruminants (PPR), a viral disease of sheep and goats, invaded Kenya through Turkana district in 2006. Kenya had remained uninfected with PPR despite bordering countries (Ethiopia, Sudan and Somalia) that were reported endemic with the disease. This study evaluated the small ruminants' pastoral management practices of Turkana pastoral herders as part of a participatory risk assessment looking at the social cultural and small stock husbandry activities that may facilitate exposure of sheep and goats to possible Peste des petit ruminants (PPR) infective herds or animals. The social cultural and small stock husbandry activities were represented by 62 variables in Peste des petit ruminants risk assessment questionnaire which were analyzed using factor analysis. The risk assessment questionnaire was developed as a Likert scale based on summated rating scale format. The risk assessment questionnaire was applied to 142 villages (*Adakars)* across six administrative divisions in north and west of Turkana District. Factor analysis extracted 7 factors that accounted for 45.3% of the variance in the reworked 49 variables analyzed. These extracted factors were thus taken as the salient factors that explained small ruminant pastoral management practices of Turkana pastoral herders as follows: 1 indiscriminate mixing of vulnerable small stock groups with high risk groups within herds; 2 introduction of new animals into the herds; 3 share watering sources leading concentration of vulnerable young stock in one point; 4 foreign livestock from across international borders grazing in local pastures; 5 nomadism and transhumance; 6 local culture of borrowing and loaning of livestock; 7 sick dams left to nurse their young kids and lambs. These seven management factors were evaluated in a regression analysis of PPR as predictors of PPR outbreak in last one and two years. The results are presented in a subsequent paper.

Keywords: Participatory risk assessment; Peste des petit ruminants; small ruminants pastoral management practices; Factor analysis

To cite this article: Kihu SM, Gitao CG, Bebora LC, Njenga MJ, Wairire GG, Maingi N, Wahome RG, 2012. Participatory risk assessment of Peste des petit ruminants: Factor analysis of small ruminants pastoral management practices in Turkana district, Kenya. Res. Opin. Anim. Vet. Sci., 2(9), 503-510.

Introduction

Peste des petit ruminants (PPR) is a highly contagious, infectious and often fatal disease of sheep, goats and wild small ruminants. The disease is caused by Peste des petit ruminants virus (*PPRV*) classified under genus Morbillivirus (Gibbs et al., 1979). The disease occurs in Middle East, Asia, China and Africa. The disease has been described in Eastern Africa region. In Kenya, it was first suspected in 1992 (FAO, 2008) and confirmed in Turkana District in 2007 (ProMed-Mail, 2007). The disease has since spread to all the arid pastoral districts in Kenya. PPR is transmitted by contacts between infected animals in the febrile stage and susceptible animals (Gopilo, 2005). Large quantities of the virus are shed through ocula-nasal discharges as well as the watery diarrhea (CFSPH, 2008). Secretions and excretions from an

Corresponding author: Kihu S.M., Faculty of veterinary medicine, University of Nairobi, P.O. Box 29053-00625 Uthiru

incubating animal contain virus 24 to 48 hours before the clinical diseases (William and Barker, 2001). Fomites in contact with infected animals such as water, feed troughs and bedding could become additional sources of infection but for very short period of time (Gopilo,i 2005). However, the *PPR* virus is very labile thus limiting its survival period outside the host to very short time (Lefvre and Diallo, 1990). There is no carrier status for PPRV (Gopilo, 2005). In general, goats are more susceptible than sheep, with sheep undergoing a milder form of the disease (Lefevre and Diallo, 1990). Other domestic animals such as cattle and pigs are known to undergo subclinical infection of PPR (Taylor, 1984). PPR has been reported as an acute and fatal disease of camel (Khalafalla et al., 2010). The disease has been reported in wild small ruminants in a zoo (Furley et al., 1987) and those living in the wilderness (Ogunsanmi et al., 2003; Sharawi et al., 2010). There are considerable differences in the epidemiologic pattern of the disease in different ecological systems and geographical areas (Gopilo, 2005). In the Sahel region, sero-prevalence of 75% is observed in pastoralist small ruminants and in most cases the disease is muted or subclinical (Grenfell and Dobson, 1995). Clinical PPR is more prevalent in the humid and sub humid regions of West Africa with morbidity of 80 to 90% resulting in mortality of about 50 to 80% (Lefevre and Diallo, 1990). These epidemics in West Africa have been associated with seasonal animal husbandry patterns and livelihood activities among the settled and pastoralist communities (William and Barker, 2001). In the Arabian country of Oman, the disease maintains itself in susceptible yearling population with an increase in incidence being a reflection of increased number of susceptible young goats/sheep recruited rather than seasonal upsurge in the viral activity (Taylor et al., 1990).

The epidemiology of PPR in Eastern Africa is less clearly understood (William and Barker, 2001). The link between the disease pattern and factors that could influence the disease dynamics including socio cultural and economic factors such as nomadism, transhumance, livestock trade or livestock rustling has yet to be fully established. Risk factors for sero-positivity in small ruminant in Tanzania have been reported as small ruminant species, livestock production system and sex in sheep (Swai et al., 2009). In a study carried out in Ethiopia, the analysis of the national serological data concluded that further studies were needed to investigate the association of the presence of disease with management practices in place (Waret-Szkuta et al., 2008). This study evaluated the small ruminants' pastoral management practices of Turkana pastoral herders as part of a participatory risk assessment looking at the risk factors that are associated with the spread of PPR in the Turkana district.

Materials and Methods

Study area

The study was carried out in Loima, Orropoi, Kakuma, Lokichogio, Kaaling and Kibish administrative divisions of Turkana District. The district is located in the extreme north west of Kenya. It is characterized by arid and semi-arid lands covered with sparse thorny shrubs. The district consists of low-lying plains with isolated rocky mountainous and hilly ranges surrounded by several seasonal rivers. The rainfall patterns and distribution is unreliable and erratic over the years. The long rains usually fall between April to June, and short rains in October–December with an annual rainfall ranging 120 mm to 430 mm. Temperatures range from a low of 24ºC to a high of 38ºC with a mean of 30ºC (ALRMP, 2009).

Turkana District has an area of 77,000 km^2 with a human population of 849,277. Small ruminants population is 3,517,151 sheep and 5,994,861 goats (KNBS 2010). Approximately 70% of the population in Turkana are nomadic or semi-nomadic pastoralists deriving their livelihood from extensive livestock production. Sheep, goats and camels are commonly grazed in the plains while cattle are grazed on the mountainous ranges where there is grass in most seasons.

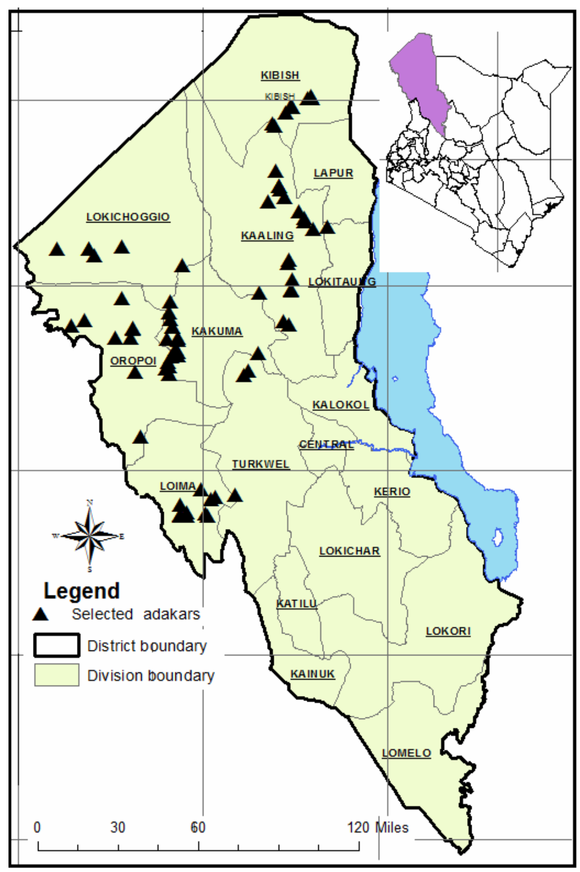

Fig. 1: Map of Turkana study sites

Sampling Unit and sample size

The sampling unit was an *Adakar*. An *Adakar* entails a cluster of often-related Turkana households that pursue similar socio-economic activities such as search for pasture, water and security, under a trusted leader (Bett et al., 2009). The number of households in each *Adakar* varies from 40 to a 100 with an average of 70 households per *Adakar* (Akabwai, 1992; AMREF, 2012). Using households' population (KNBS, 2010) for all six administrative divisions in this study, a total population of 535 *Adakars* was estimated using the average number of households per *Adakar* at 70. All the *Adakars* were allocated numbers and using a random number generator (Microsoft Excel) the study sample of 143 *Adakars* (Hatcher 1994; Kim, 2008; Pallant, 2005) was selected by simple random sampling proportionate to population size of each administrative division.

Data collection

Risk assessment questionnaire

The study primarily examined the complex interrelationship between various variables describing sheep and goat husbandry, related small stock production and social cultural activities in the pastoral set up of Turkana community that may lead to direct or indirect exposure of small stock to possible PPR infected animals or livestock herds. The Turkana herders identified the four age groups of the small stock based on age (young kids and lambs < 2 months, older kids and lambs >2 but < 5 months, young sheep and goats > 6 months but < 24 months and adults > 24 months). Through key informant interviews, it was established that each age received varied managerial attention in terms of herding care and disposal based on social cultural significance of the age group. Therefore, variables for the risk assessment were developed for each of the four age groups looking at herding care, off-take and restocking patterns for each age group. The risk assessment questionnaire consisted of 62 variables and was developed as a Likert scale based on summated rating scale format as described by Spector (1992). The variables in the survey questionnaire were rated by scale of five items that were assigned risk scores. In all the frequency structured scales, a high score indicated high risk while in the agreement structured scales, high score indicated low risk. At analysis level, all the agreement structured scales were reverse-coded so that high score depicted high risk (DeCoster, 2005). The questionnaire was pretested and relevant adjustment made prior to final study.

Focus group discussion

The participatory risk assessment entailed administration of the risk questionnaire orally to a small focused group of about five to 15 respondents being representatives and key informants of each *Adakar* interviewed. The scale items were translated in local Turkana language for ease of scoring the respondent responses. The interviewer with help of local Turkana language interpreter led a discussion on each question following which an agreed scoring was recorded for each variable based on agreement reached between the respondents in their group discussion.

Data management and analysis

The data collected from the field was entered, cleaned and constructed in Microsoft Excel (Microsoft Corp., Redmond, WA). The data was then exported to SPSS statistical software version 17.0 (IBM Corp., Armonk, NY) for exploratory factor analysis. Maximum likelihood method of common factor analysis was used for the extraction of the latent factors. Common factor analysis assumes all factors are related to some degree and that those that share same dimensions (latent factors) are highly correlated compared to those that do not share dimensions thus yielding low correlations (Basto and Pereira, 2012). Therefore common factor analysis uncovers the latent factor structure of a set of variables and explains the correlations among the variables (Kim 2008, Basto and Pereira, 2012), The factorability of the variables was assessed by correlation matrix where some correlations had to be > 0.3 (Tabachnick & Fidell, 2007). Anti-image correlation matrix diagonals were examined to ensure they were > 0.5 while anti-image correlation matrix diagonals that were < 0.5 were considered for exclusion from analysis (Field, 2009). Finally a measure of sampling adequacy Bartlett's test of sphericity (Bartlett, 1954) was checked for significant and Kaiser-Mayer Olkin (KMO) (Kaiser, 1970) measure of sampling adequacy checked to be > 0.6. The initial extracted factors were then rotated using orthogonal factor rotation (varimax rotation) so as to obtain results that had a simplified structure that was easier to interpret (Tabachnick and Fidell, 2007). Rotated factors with factor loading >0.40 were retained for interpretation (Berghaus et al, 2005). In determining the number of factors to retain for interpretation four criteria was used. First retaining factors with eigenvalue greater >1 (Kaiser rule); second identifying the break point (elbow) on graph plot of factors and eigenvalues and select factor above elbow (Scree method) (Cattell, 1966), third parallel analysis based on Monte Carlo random simulated eigenvalues which form a criterion for comparison with actual eigenvalues from raw data (O'Connor, 2000). Raw data eigenvalues larger than criterion are retained in parallel analysis. The final and also important criterion is the selection of those factors whose interpretation based on variables in them makes sense (Boklund et al., 2004).

Results

Risk assessment data from 142 *Adakars* were included in the analysis. Suitability of the data for factor analysis was assessed. Inspection of correlation matrix revealed the presence of many correlations coefficients ≥ 0.3. Kaiser-Mayer-Olkin value was 0.77 while Bartlett's test of Sphericity reached statistical significance at p=.000 thus supporting the factorability of the correlation matrix. Out of 62 initial variables, 49 variables with anti-image correlation matrix diagonals coefficients >0.5 were used for final analysis. Thirteen variables out of the original 62 variables were excluded from the analysis as they lacked sufficient correlation with other variables (Field, 2009). The initial outcome of the factor analysis resulted in thirteen factors that had eigenvalues ≥ 1 suggesting 13 factors should be retained for interpretation based on Kaiser rule. However, the Scree method as shown in Figure 1 suggests three to seven factors to be retained based on elbow in the shape of plot.

The initial outcome was further analyzed with parallel analysis as shown in Table 1 below resulting in selection of seven factors with eigenvalues exceeding the corresponding criterion values for randomly generated eigenvalues.

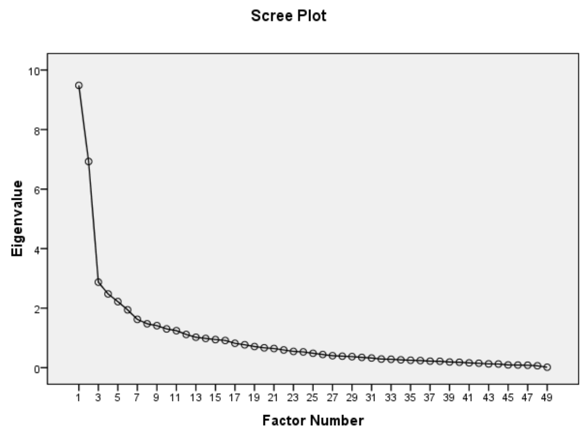

Fig. 1: Scree plot of Eigenvalues of 49 potential factors extracted during the factor analysis.

Final analysis based on observation of factors and what made sense confirmed the selection of seven factors that accounted for 45.3% of the variance. Most variables loaded highly on single factor in a simplified structure that was easier to interpret as shown on Table 2 though there were five variables Q 3.12, Q3.13, Q3.22, Q3.30, Q3.33 and Q3.38 which loaded on two factors each. The double loading of variables was an indication that these variables were moderately related

Table 1: Parallel analysis comparison of eigenvalues of the first 13 potential factors and randomly generated eigenvalues

PARALLEL ANALYSIS:

Common Factor Analysis & Random Normal Data Generation

Ncases 142
Nvars 49
Ndatsets 1000
Percent 95

Raw Data Eigenvalues, & Mean & Percentile Random Data Eigenvalues

Root	Raw Data	Means	Prcntyle
1.000000	9.241653	1.728661	1.892827
2.000000	6.653294	1.570442	1.695623
3.000000	2.548488	1.452989	1.555119
4.000000	2.134717	1.356610	1.452778
5.000000	1.885743	1.267366	1.356536
6.000000	1.584049	1.185996	1.262012
7.000000	1.234096	1.111910	1.183196
8.000000	1.106868	1.042128	1.114663
9.000000	1.004826	.977408	1.044895
10.000000	.958579	.915496	.979381
11.000000	.863723	.855793	.916646
12.000000	.722589	.798238	.859888
13.000000	.644426	.743273	.798538

Table 2: The seven factors extracted from 49 variables of PPR risk assessment

Rotated Factor Matrix

	Factor variables	Factor						
		1	2	3	4	5	6	7
Q3.25	Sick adults stock watered on same troughs with older kids/lambs	.860						
Q3.23	Older kids/lambs share the same watering troughs with older animals	.718						
Q3.18	Older kids/lambs graze alongside wild herbivores.	.708						
Q3.38	Extent of watering young goats/sheep at separate water holes	-.684		.446				
Q3.41	Sick young goats/sheep watered in communal water holes	.657						
Q3.26	Sick adult stocks grazed along with older kids/lambs	.625						
Q3.36	Frequency young sheep and goats graze along with wild herbivores	.609						
Q3.40	Sick young sheep/goats separated from other	-.526						
Q3.62	Traders graze their animals alongside herds on their way to the markets	.468						
Q3.39	Young goats/sheep share the same watering troughs with older animals	.447						
Q3.44	Frequency of young goats/sheep returned home after failed market sale		.873					
Q3.61	Frequency of adult goats/sheep returned home from failed market sale		.769					
Q3.47	Extent of goats/sheep sourced from markets used to restock herds		.650					
Q3.29	Extent of young goats/sheep bought from markets used to restock herds		.570					
Q3.45	Extent of introduction into herds goat/sheep gifts from ceremonies		.538					
Q3.30	Extent of young goats/sheep got through raids used to restock herds		.520			.469		
Q3.13	Extent of kids/lambs bought from markets used to restock herds		.502	-.405				
Q3.33	Young goats/sheep grazed in common pasture		-.465		-.445			
Q3.48	Extent of adult goats/sheep got from raids used to restock herds		.465					
Q3.21	Extent of watering older kids/lambs at separate times			.681				
Q3.7	Extent of watering young kids/lambs at separate times from other stock			.582				
Q3.22	Extent of watering older kids/lambs at separate water holes	-.436		.544				
Q3.37	Extent of watering young goats/sheep at separate times			.528				
Q3.8	Extent of watering young kids/lambs at separate water holes			.506				
Q3.14	Extent of older kids/lambs got through raids used to restock herds			-.478				
Q3.53	Extent of herds from neighboring countries graze in local pastures				.923			
Q3.54	Extent of herds from neighboring countries watering in local pastures				.871			
Q3.43	Frequency of young goats/sheep lost through raids returned back					.830		
Q3.60	Extent of young goats/sheep got through raids used to restock herds					.686		
Q3.5	Young kids/lambs moved with other animals during transhumance					.582		
Q3.19	Older Kids/lambs moved with other animals during transhumance					.436		
Q3.28	Extent of exchange of young goats/sheep on loans						.665	
Q3.46	Frequency of exchange of adult goats/sheep/ on loan						.615	
Q3.11	Sick adult stock are watered on same troughs with young kids/lambs							.887
Q3.9	Young kids/lambs share the same watering troughs with older animals							.476
Q3.12	Sick adults stocks are grazed along with young kids/lambs				-.408			.444

Based on the variables in each factor and considering the variables with heavy loading on the factor a description representing the general theme of the factor was generated. The list of factors with their descriptive theme title in the final factor model as listed below.

Factor 1 Indiscriminate mixing of vulnerable group with high risk group within herds
Factor 2 Introduction of new animal into the herds
Factor 3 Share watering source leading concentration of young stock in one point
Factor 4 Foreign stock from across international borders grazing in local pastures
Factor 5 Nomadism and transhumance
Factor 6 Local culture of borrowing and loaning of livestock
Factor 7 Sick dams left to nurse their young kids/lambs

to both factors (Berghaus et al., 2005). It is also observed that variable Q3.22, Q3.38 and Q3.40 load negatively on factor one. Assessment of Q3.22 and Q3.38 “Extent of watering older kids and lambs at separate water holes” and “Extent of watering young goats and sheep at separate water holes” shows that if these actions happened there would be reduced contacts and possibly reduced risk thus the negative loading while opposite would have been watering goats in common hole thus increasing contacts and risk. Similarly Q 3.40 “Sick young sheep and goats are separated from other stock” would reduce the risk thus negative loading. Other variables loading negatively were Q3.33 on factor two, Q3.13 and Q3.14 on factor 3, Q3.12 and Q3.33on factor 4 but variable loadings were low and their description did not fit the general theme of the factors they loaded on.

Discussion

The seven factors extracted as potential risk variables for PPR are assessed in relation to pastoral livestock management as practiced by the Turkana pastoral herders. Turkana community livelihood is hinged on pastoralism practiced in some of the harshest and most arid land of northwest Kenya (Weinpahl, 1985). Turkana pastoralists are thus very mobile community in search of pasture and water for their livestock. Decisions relating to livestock management in Turkana are made based on labor availability, herd size, social obligations and perceptions of the environment in terms of security, forage and water availability (McCabe, 1984).

In examining the factors in the model, factor 1 is strongly loaded by variables highlighting the most vulnerable groups of older kids and lambs; and young sheep and goats making contacts with high risk groups such as wildlife and sick adults through sharing of water holes, troughs and grazing. The indiscriminate mixing of sick animals and wildlife during grazing poses a health risk to the herd. The deliberate decision of the pastoral Turkana herder to allow sick animals to commingle with health ones can be explained from point of labor shortage. Households with abundant labor segregate their herds of livestock into herding groups based on species, age, production status and health status. Wildlife such as dikdik *Madoqua guentheri* is common in Turkana dry land savannah and graze along with small stock in the savannah shrubs.

Factor 2 strongly loaded variables highlighting introduction of new animals into a herd. Such introduction may come from market purchases, gift from cultural ceremonies and raids (de Vries, 2002). Variables depicting unsold small stock returned home from market sale yard loaded highly on factor 2. At the market sale yard animals from various locations are concentrated in closed pens therefore creating a high risk environment to contract diseases which can be spread to herds where bought animal are destined to go. Source of animal gifts as well as raids may be herds that were infected. It is told that in last serious PPR outbreak in Turkana in 2006, the pastoral herders realizing the immense danger they faced of losing their small stock they rushed to settle their social cultural obligations that required giving out of small stock to other clan members. This action aided in increasing the risk PPR spread to other herds.

Factor 3 loaded variables that highlight watering of the younger groups of sheep and goats. Water is a scarce commodity in Turkana and a single water source may serve several herds. In situations where water and labor is abundant, animals of different age groups are watered at different times and places. The very young kids and lambs are watered at home. However in the very dry seasons all animals may be seen crowding in a single water hole waiting their turn to drink consequently increasing possibility of making infective contacts.

Factor 4 loaded highly on variables mentioning invasion of local pastures by foreign herds from across international borders. During the severe drought, even the communities who are adversaries will grant each other passage to pasture and water. It is at this time that pastoralists will cross international borders in search of pasture and water. Turkana community expressed their concern that foreign animals brought disease into their pastures. Such concerns were based on fact that the Turkana community had little knowledge of whether the foreign animals had received adequate protective animal health care before getting into their pasture.

Factor 5 had high correlations on livestock raids and transhumance focusing on older lambs and kids as well as young sheep and goats. As previously mentioned Turkana community are pastoralists and thus a very mobile in search for pasture and water to sustain their livestock (Fry and McCabe, 1986). It is this mobility that exposes their livestock to share pastures with herds that could be exposed to diseases. Livestock raids are common cultural activity among the Turkana and the neighboring communities. Despite the perceived gains from raiding, Turkana herders aver that raided animals are also known to spread disease to herds they end up to.

Factor 6 was correlated with loaning of livestock. In Turkana begging livestock is an accepted normal and people negotiate to be given animals by their clansmen or age mates (Renfrew 1990; Sakumichi 1997; de Vries, 2002). In such circumstances animals given out are those that are of less benefit to the owner. Therefore it is high risk to borrow animals from a sickly herd because the owner will readily hand them over to borrower who will end up with liability of paying back whether the animals survive or not.

In factor 7 key variables loading on the factor have general theme of sick adult goats and sheep sharing grazing and water with kids and lambs. From the interviews, it was emphasized that sick livestock were left to graze with kids and lambs around the homestead this include sick dams that are allowed continue nursing their young ones.

Conclusions

From the assessment of results of the factor analysis model it was found that the seven factors describe some of the livestock management decisions made by Turkana herders at household level and *Adakar* level in their management of small ruminants. The management decisions were made in response to constraints experienced by the herders such as labor shortage, pasture and water availability, social cultural obligations, herd health, need to expand herd size and prevailing security situations. To overcome these constraints Turkana herders have developed strategies which constitute among others the seven management factors extracted from factor analysis model.

Acknowledgement

The research output in this paper is part of PhD study being undertaken by Simon Kihu. Acknowledgement is made to RUFORUM (RU/CFP/ CGS/ TADS/09/1) for financial support, FAO Kenya and PENAPH for support of field training of research team in participatory epidemiology and Vetworks Eastern Africa for logistical assistance throughout this study.

References

Akabwai D. 1992. Extension and livestock development: Experience from among the Turkana pastoralists of Kenya. *Pastoral Development Network Paper,* 33b ODI (Overseas Development Institute), London, UK, 14 pp.

ALRMP 2009. *Baringo district and Samburu district profiles*, The Arid Lands Resource Management Project II, Website; http://www.aridland.go.ke/arid_profiles/turkana_profile.pdf. Accessed on 27th August 2010

AMREF 2012. AMREF, Ngâ'Anadakarin Bamocha - Integrated Health and Social Development Programme, website: http://www.amref.org/what-we-do/nganadakarin-bamocha--integrated-health-and-social-development-programme/ Accessed on 17th February 2012

Bartlett, M.S. 1954. A note on the multiplying factors for various chi square approximations. *Journal of Royal Statistical Society,* 16(Series B), 296-298.

Basto, M. and Pereira, J.M. 2012. An SPSS R-Menu for Ordinal Factor Analysis. *Journal of Statistical Software January 2012*, Volume 46, Issue 4. http://www.jstatsoft.org/

Berghaus, R.D., Lombard J.E., Gardner I.A. and Farver, T.B. 2005. Factor analysis of a Johne's disease risk assessment questionnaire with evaluation of factor scores and a subset of original questions as predictors of observed clinical paratuberculosis. *Preventive Veterinary Medicine,* 72 (2005) 291–30

Bett, B., Jost C., Allport R. and Mariner, J. 2009. Using participatory epidemiological techniques to estimate the relative incidence and impact on livelihoods of livestock diseases amongst nomadic pastoralists in Turkana South District, Kenya. *Preventive. Veterinary. Medmedicine,* 90:194-203.

Boklund A., Alban L., Mortensen S. and Houe H. 2004. Biosecurity in 116 Danish fattening swineherds: descriptive results and factor analysis. *Preventive Veterinary Medicine,* 66 (2004) 49-62.

Cattell, R.B. 1966. The scree test for the number of factors. *Multivariate Behavioural Research,* 1: 245-276.

CFSPH 2000. Peste des Petits Ruminants - CFSPH Technical Disease Fact Sheets . DPR_A2008 © 2008 CFSPH. Website: www.ivis.org/advances/Disease_Factsheets/peste_des_petits_ruminants.pdf . Accessed on 21st May 2009

DeCoster, J. 2005. Scale construction notes. Website: http://www.stat-help.com/notes.html. Accessed on 2nd January 2011

De-Vries, D.H. 2002. Livestock redistribution dynamics in nomadic pastoralist herd demography: A case study among the ngisonyoka Turkana of south Turkana, Kenya. *A thesis* submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment for the degree of Master of Arts in the Department of Anthropology. Chapel Hill 2002.

FAO 2008. Peste des petits ruminants (PPR) in Morocco. EMPRES WATCH August 2008. Website: ftp://ftp.fao.org/docrep/fao/011/aj120e/aj120e00.pdf. Accessed on 21st may 2009.

Field, A.P. 2009. *Discovering statistics using SPSS*, London, England : SAGE.

Fry, P.H. and McCabe J.T. 1986. A comparison of two survey methods on pastoral Turkana migration patterns and the implications for development planning. *Pastoral development network, Agricultural Administration Unit, Overseas Development Institute,* Paper 22b September 1986.

Furley, C.W., Taylor, T.W. and Obi, T.U. 1987 An outbreak of PPR in a zoological collection. *Veterinary. Record*, 121: 443-447.

Gibbs, P.J.E., Taylor, W.P. Lawman, M.P. and Bryant, J. 1979 Classification of the peste des petits ruminants virus as the fourth member of the genus Morbillivirus. *Intervirology,* 11: 268 – 274.

Gopilo, A. 2005. Epidemiology of Peste des Petits Ruminants virus in Ethiopia and molecular studies on virulence. *PhD thesis*. Institut National Polytechnique de Toulouse.

Grenfell, B.T. and Dobson A.P. 1995. *Ecology of infectious diseases in natural populations*, Edition: illustrated, reprint Published by Cambridge University Press, 1995 ISBN 0521465028, 9780521465021, 521 pages.

Hatcher, L., 1994. *Exploratory factor analysis. A Step-by-Step Approach to Using the SAS System for Factor Analysis and Structural Equation Modeling,* SAS Institute, Cary, USA, pp: 57–127.

Kaiser, H.F. 1970. A second generation little jiffy. *Psychometrika,* 35, 401–415.

Khalafalla, A.I., Saeed I.K., Ali Y.H., Abdurrahman M.B., Kwiatek O., Libeau G., Obeida A.A. and Abbas, Z. 2010. An outbreak of peste des petits ruminants (PPR) in camels in the Sudan *Acta Tropica,* Volume 116, Issue 2, November 2010, Pages 161-165.

Kim, H. 2008. Common Factor Analysis Versus Principal Component Analysis: Choice for Symptom Cluster Research. *Asian Nursing Research,* March 2008 Vol 2 No 1

KNBS 2010. 2009 Kenya population and housing census Volume 1 A, Population distribution by administrative units. Kenya National Bureau of Statistics, August 2010

Lefèvre, P.C. and Diallo, A. 1990. Peste des petites ruminants. *Revue Scientifique Office International des Epizooties, 9*: 951-965.

McCabe, J.T. 1984. Food and the Turkana in Kenya. Nomads: Stopped in Their Tracks? Cultural Survival Quarterly Back Issues 8.1 (Spring 1984) Website: http://www.culturalsurvival.org/publications/cultural-survival-quarterly/81-spring-1984-nomads-stopped-their-tracks. Accessed on 25th June 2012

O'Connor, B.P. 2000. SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instruments & Computers,* 32 (3): 396-402

Ogunsanmi, A.O., Awe E.O., Obi T.U. and Taiwo V.O. 2003. Peste des petits ruminants (PPR) virus antibodies in african grey duiker (sylvicapra grimmia). *African Journal of Biomedical Research*, Vol. 6 (1); 59 – 61 (2003)

Pallant, J. 2005. SPSS Survival Manual: a step by step guide to data analysis using SPSS version 12. 2nd Edition.

ProMed-Mail, 2007. Peste des petits ruminants - Kenya (Rift Valley): OIE. 20070117.0226: Website : http://www.promedmail.org/pls/otn/f?p=2400:1001:4263237816442653::::F2400_P1001_BACK_PAGE,F2400_P1001_ARCHIVE_NUMBER,F2400_P1001_USE_ARCHIVE:1202,20070117.0226,Y. Accessed on 21st May 2009

Renfrew, M.P. 1990. "Lopae: geographical dispersal of friendship in Turkana" Working paper no: 472. Institute for Development Studies. University of Nairobi.

Sakumichi, S. 1997. Coping with illness in Turkana: A preliminary report .*African Study Monographs,* 18(3,4): 229-240, December 1997. Hirosaki University

Sharawi, S.S., Yousef M.R., Al-Hofufy A.N. and Al-Blowi, M.H. 2010. Isolation, serological and real time PCR diagnosis of Peste Des Petites Ruminants virus in naturally exposed Arabian Gazelle in Saudi Arabia. *Veterinary World*, (11):489-494

Spector, P.A. 1992. Summated Rating Scale Construction: An Introduction. Newbury Park, CA, Sage. VandeWalle, D.

Swai E.S., Kapaga, A., Kivaria, F., Tinuga, D. Joshua, G. and Sanka, P. 2009. Prevalence and distribution of Peste des petits ruminants virus antibodies in various districts of Tanzania. *Veterinary Research Communications,* 33:927–936

Tabachnick, B.G. and Fidell, L.S. 2007. *Using multivariate statistics* (5th ed.). Boston: Allyn and Bacon.

Taylor, W.P. 1984. The distribution and epidemiology of PPR. *Preventive Veterinary Medicine*, 2: 157-166.

Taylor, W.P., Busaidy S.A. and Barret T. 1990. The epidemiology of peste des petits ruminants in the sultanate of Oman. *Veterinary Microbiology*, 22(4): 341-352.

Waret-Szkuta, A., Roger F., Chavernac D., Yigezu L., Libeau G., Pfeiffer D. U. and Guitián J. 2008. Peste des Petits Ruminants (PPR) in Ethiopia: Analysis of a national serological survey. *BioMed Central (BMC) Veterinary Research,* 4:34.

Wienpahl, J. 1985. Commision on Noomadic peoples. "Turkana herds under environmental stress" *Nomadic people*, Number 17 February 1895.

William, E.S. and Barker, I.K. 2001. *Infectious diseases of wild mammals*. Edition: 3, illustrated Published by Wiley-Blackwell, 2001, ISBN 0813825563, 9780813825564; 558 pages.