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Epidemiology of morbidity and mortality on smallholder dairy farms in Eastern and Southern Africa

A dissertation presented in partial fulfilment of the requirements for the degree of Master of Veterinary Studies in Epidemiology at Massey University

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Abstract

Morbidity and mortality are important causes of economic losses on dairy farms worldwide. In order to minimize these losses, the causes of morbidity and mortality and the associated risk factors need to be identified and appropriate control measures implemented. With the advent of globalization, more and more countries have sought to belong to regional groupings. One such grouping is the Common Market for Eastern and Southern Africa (COMESA). COMESA not only promotes trade but also encourages regional integration of research in areas such as agriculture. However, little is known about the causes of morbidity and mortality and their risk factors on smallholder dairy farms in Eastern and Southern Africa (ESA) as a region. This thesis focuses, firstly, on the qualitative analysis of available scientific knowledge in order to identify the causes and associated risk factors for morbidity and mortality in ESA and, secondly, on the analysis of spatial patterns of excess mortality on smallholder dairy farms in Tanzania.

A systematic review was conducted on the causes of morbidity and mortality on smallholder dairy farms in ESA. Mastitis, tick-borne diseases (TBDs), tick infestation and diarrhoea were the major causes of morbidity. TBDs, diarrhoea and trypanosomiasis were the major causes of mortality; however, a substantial number of mortalities with undiagnosed causes were also reported. This review also identified that the strong protective factors for mastitis were residual calf suckling and leaving one quarter unmilked; while teat lesions, tethering, washing teats only prior to milking, use of udder towel and poor body condition score were the main risk factors for mastitis. Zero-grazing was highly protective of TBDs while agro-ecological zone (AEZ), age and district were risk factors.

Survival analysis using a Cox regression model fitted with a gamma-frailty term was employed to explore excess mortality on smallholder dairy farms in Tanga and Iringa regions of Tanzania. First- and second-order spatial patterns of farm frailty were analyzed. First-order patterns were recognizable in both regions, with large clusters
around Tanga town and Iringa town respectively. The analysis did not provide evidence of second-order clustering.

More intervention studies are recommended for the ESA region in order to better identify animal health constraints and their associated risk factors. Targeted research at aggregates of areas with high mortality would be the most cost-efficient way to identify the important risk factors.
Dedications

To Misozi, thank you for all your loving support and encouragement for me enroll into this programme, I will always wish you were here to see this to the end. Joackim and Sam, you remained my source of inspiration and a reason to go on. This one is for you.
Acknowledgements

It seems just like yesterday when I first arrived at the EpiCentre wondering what I was getting myself into. Sitting in front of a computer manipulating numbers all day was not my idea of a veterinarian’s career. After six months of statistical concepts, journal club, study group and everything else that went along with them, I realized I was in the cohort. Surely, this was not part of the original script. Days of my undergraduate training when we used to anxiously wait for the epidemiology session to end and rush for surgery seemed ancient. It was time to make the best out of the situation; I was now one of them anyway.

I would not have made it through without the support and help of many individuals. Thus, my sincere thanks go to all staff and students at the EpiCentre, IVABS and Hopkirk research institute. I gratefully acknowledge the great assistance and guidance of my supervisors Jackie Benschop and Nigel French. Jackie you really tolerated my impatience and nagging in the last few weeks, you have an awesome motherly heart. Special thanks to Mark Stevenson and, his family, for the wonderful support both academically and socially. Naomi Cogger and Grant Skilton you filled our little house with furniture and made it a home; Eve Pleydell, you spotted misplaced commas in my work and those mountain trips were truly unforgettable. May you all be showered with blessings. Heartfelt thanks to my mother, brothers and sisters, you were there for me through and through. Mum, you were thousands of miles away yet your unfailing motherly love was so warm and comforting, as ever, especially in times of difficulties; I thought I was weaned a long time ago. I sincerely appreciate the financial support from NZAID that made my study and stay in New Zealand a reality and the Government of Zambia for allowing me to take leave from my job in order to pursue this training.

For everyone not mentioned above but contributed positively or negatively, in a small way or big way to my successful stay in New Zealand, a million thanks to you individually and severally. I will certainly have fond memories of the wonderful EpiCentre/Hopkirk team for a long time after all this is done and dusted. Praise be to God for my very existence and the intellect to get this done.
# Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AEZ</td>
<td>Agro-ecological zone</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>COMESA</td>
<td>Common Market for Eastern and Southern Africa</td>
</tr>
<tr>
<td>CRD</td>
<td>Center for Reviews and Dissemination</td>
</tr>
<tr>
<td>EAC</td>
<td>East African Community</td>
</tr>
<tr>
<td>ECF</td>
<td>East Coast Fever</td>
</tr>
<tr>
<td>ESA</td>
<td>Eastern and Southern Africa</td>
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<tr>
<td>IQR</td>
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