Situational analysis of bovine tick-borne diseases and control in Tanzania: A retrospective study

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SUMMARY

Tick-borne diseases (TBD) are among the main causes of morbidities and mortalities in cattle leading to economic losses to livestock keepers in Tanzania. Following Government investment in TBD control through dipping, a retrospective study was conducted to evaluate the trends in dipping and TBD occurrence in cattle from January 2018 to June 2023. The study involved retrieving the data of distribution of active dip tanks, immersions /number of dipped cattle, and TBD cases reported in the annual surveillance reports in the DVS office at the Ministry of Livestock and Fisheries (MoLF). The data were analyzed and summarized by use of Microsoft Excel 2007. Descriptive statistics was used to establish the trends, distribution and temporal pattern of TBD occurrence. During five and half years, the number of dipped cattle increased from 22,400,170 in 2018/2019 to 456,027,356 in 2022/2023. The number of reported TBD decreased from a total of 34,158 cases in 2018 to a total of 8,054 cases in 2022. Trends of mortalities decreased from 4,072 in 2018 to 878 in 2022. TBD cases were distributed in all regions throughout the year with the highest magnitude recorded during the rainy season. There is a significant decrease in trends of TBD cases and mortalities with an increase in trends of dipping. This indicates the effectiveness of TBD control through dipping. For effective and sustainable TBD control in the country, education to livestock keepers on uninterrupted dipping is required coupled with regular monitoring and evaluation of the dipping practice.

Keywords*: Acaricide, Tick-borne diseases, Subsidy, Dip tanks and Dipping.*

INTRODUCTION

Ticks and tick-borne diseases (TTBD) are the major drawbacks to livestock production in particular cattle in sub-Saharan Africa (Mbassa *et al.,* 2009). Favorable climate for survival and multiplication of ticks makes TBD to be prevalent in many tropical countries (Laisser *et al.,* 2017). Tick density is high just after the rainy season and it goes along with increased incidences of TBD (Tabor *et al.,* 2017). Ticks are vectors of several pathogens that infect and cause diseases in animals and humans (Neto *et al*., 2015).

Tick-borne diseases cause high economic losses affecting the livelihood of livestock keepers through retarded animal growth rates, reduced productivity, lowered fertility, reduced quality of hides and skin and deaths (Chenyambuga *et al.,* 2010). Tick-borne diseases have hindered efforts to achieve optimal livestock production and improvement (Laisser *et al*., 2017). In Tanzania, annual loss due to TTBD in cattle was estimated at 864 billion Tanzania Shillings equivalent to 364 million USD with ECF accounting for 68% of the losses (Kivaria, 2006). Extensive grazing under traditional cattle rearing, lack of consistency in acaricide application and poor tick control strategies are among the predisposing factors to ticks infestation (Nonga *et al.,* 2012, Laisser *et al.,* 2014).

Tick borne diseases prevalence is related to climate, vegetation, vector dynamics, host susceptibility, grazing systems and tick control practices (Mamiro *et al*., 2016). The presence of heavy rains and favorable temperatures in the tropical climate favors multiplication of ticks and if tick control is not effectively done high incidences of TBD are expected. In Tanzania, ticks are widely distributed and this goes along with the

incidence of TBD (Kerario *et al*., 2017). The commonly reported TBD in cattle in the country includes East Coast Fever (ECF), Anaplasmosis, Babesiosis and Heartwater (Kazungu *et al*., 2015).

Since 2018, the Government of Tanzania revitalized the efforts in control of TTBD through acaricide application. This was adopted after the failure of supply of subsidized acaricide in 2013/2014 due to economic constraints after the finalization of the District Agricultural Development Plan (DADP) project (Mbassa *et al.*, 2017, unpublished report). The MoLF developed a Livestock Disease Control Strategy of 2018, advocating TTBD control by adopting a participatory approach for sustainability. Control of ticks by use of acaricides in ruminants has been made mandatory as per the Animal Diseases (Acaricides Application and Management) Regulations of 2019.

For five- and half-year period from 2018 to June 2023 the Government of Tanzania has made heavy investment in control of TTBD by supplying a total of 128,860.04 litres of subsidized acaricides to all functional dip tanks. During this period a total of 747 new dip tanks were constructed and 1,014 dip tanks rehabilitated in the country (URT, MLF, 2023). The performance of dipping as a principal TTBD control method after the Government's significant investment in the country has not been evaluated. Trends and distribution of cases and mortalities of TBD is a good indicator of a functional control strategy. The generated data will provide evidence-based information for sustainable control of TBD to reduce resulting losses. This study thus assessed trends of dipping and TBD occurrence in cattle in Tanzania.

MATERIALS AND METHODS

Study design

The study employed a retrospective design to analyze data spanning five and a half years, from January 2018 to June 2023. The data were obtained from annual and bi-annual reports archived at the Ministry of Livestock and Fisheries (MoLF) in Tanzania. These reports contained information submitted by various regions on tick control measures and tick-borne diseases (TBD) occurrences.

Data collection

This retrospective study utilized archived surveillance data to examine trends in TBD control and reported cases across Tanzania's mainland. The objective was to assess tick control efforts and the prevalence of TBD over a five-and-a-half-year period. The data were retrieved from soft copies of annual surveillance reports available at the MoLF. These reports were systematically reviewed, and relevant data were filtered to capture TBD-related cases from January 2018 to June 2023. The variables collected included the number of reported cases and deaths attributed to TBD, the distribution and functionality of dip tanks, and the number of cattle immersions in functional dip tanks

Data analysis

The data were compiled in Microsoft Excel 2007 for analysis. Descriptive statistics were used to assess trends in cattle dipping and the incidence of TBD. Key variables analyzed included region, date of TBD case reporting and number of reported cases and mortalities. The distribution of functional dip tanks and reported TBD cases was summarized using Excel tables. Temporal patterns of TBD occurrence were analyzed through monthly aggregation of cases over the study period, and trends were visualized using line graphs.

RESULTS

Distribution of functional dip tanks and cattle dipping in Tanzania

There are 2,732 total dip tanks in Tanzania mainland (Table 1). However, 2,137 dip tanks are functional and 595 are nonfunctional. The highest number of functional dip tanks was reported in Simiyu (180), Arusha (171) and Dodoma (149). Regions with the least functioning dip tanks include Mtwara (17), Lindi (29) and Kilimanjaro (30). The number of dipped cattle has been increasing from 22,400,170 total immersions in 2018/2019 to 456,027,356 total immersions of dipped cattle in 2022/2023 (Table 2).

Trends of tick-borne diseases (TBD) and TBD related mortalities.

From the findings of the study, it was observed that the trends of TBD cases have been decreasing from the year 2018 to June 2023 (Table 3). The investigated data indicated that the proportion of animal mortalities due to TBD decreased serially in the five consecutive years from 2018 to 2023 as indicated in Table 4.

Table 1: Distribution of functional dip tanks in Tanzania as at June 2023

Region	Functional dips	Non-functional dips	Total dips
Arusha	171	29	200
Dodoma	149	19	168
Geita	62	19	81
Iringa	122	29	151
Kagera	98	22	120
Katavi	49	3	52
Kigoma	57	24	81
Kilimanjaro	30	27	57
Lindi	29	8	37
Manyara	140	9	149
Mara	112	52	164
Mbeya	69	2	71
Morogoro	43	12	55
Mtwara	17	15	32
Mwanza	95	50	145
Njombe	91	16	107
Pwani	61	11	72
Rukwa	99	19	118
Ruvuma	51	43	94
Shinyanga	53	31	84
Simiyu	180	47	227
Singida	107	48	155
Songwe	44	16	60
Tabora	120	17	137
Tanga	88	27	115
Total	**2137**	**595**	**2732**

Table 2: Number of dipped cattle in Tanzania from 2018/2019 to 2022/2023

Year	Total dipped cattle
2018/2019	22,400,170
2019/2020	149,954,080
2020/2021	368,511,623
2021/2022	445,899,064
2022/2023	456,027,356
Total	**1,442,792,293**

Table 3: Trends of cases of Tick-Borne Diseases reported in Tanzania from 2018 to June **2023**

YEAR	ECF	Anaplasmosis	Babesiosis	Heartwater
2018	10,491	15,366	4,376	3,925
2019	7,069	8,836	2,309	2,200
2020	6,036	6,874	1,425	966
2021	4,742	4,526	259	43
2022	3,515	4,319	193	27
2023	1,290	2,830	87	22
TOTAL	**33,143**	**42,751**	**8,649**	**7,183**

Table 4: Mortalities caused by tick-borne diseases in Tanzania from 2018 to June 2023

Year	ECF	Anaplasmosis	Babesiosis	Heart water
2018	1,480	1,869	307	416
2019	1,517	632	249	268
2020	889	656	134	106
2021	553	475	63	13
2022	505	345	20	8
2023	247	301	12	5
Total	**5191**	**3,622**	**785**	**816**

Distribution of tick-borne disease cases in Tanzania

The TBD were reported in all months of the year from January 2018 to June 2023. Anaplasmosis has the highest total number of reported cases for five and half years with 42,751 cases. ECF has the highest total number of cases reported in January in the five consecutive years having a total of 4,443 cases followed by Anaplasmosis (4,248), Heartwater (1,426) and Babesiosis (1,153). For all TBD high number of cases were reported in January, March, April, May, June and November. The total cases of TBD decreased from June to October in all reported cases of TBD in five and half years from 2018 to June, 2023 (Figure 1). The highest total TBD cases were reported in Tanga, Manyara, and Mara regions while the lowest total cases of TBD were reported in Dar es Salaam and Mtwara regions (Table 5).

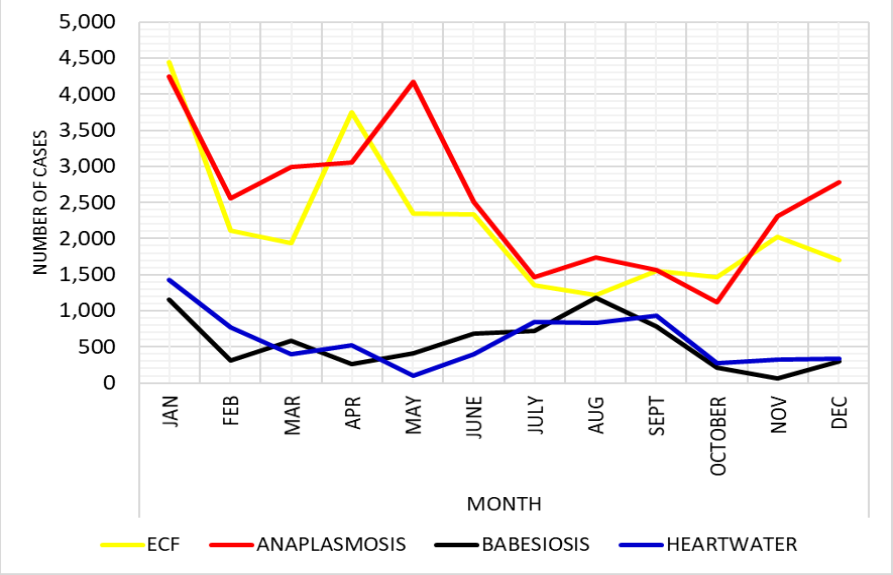

Figure 1: Temporal distribution of Tick-Borne Diseases in cattle in Tanzania from January 2018 to June 2023

Table 5: Distribution of Tick-Borne Disease cases in Tanzania

Region	ECF	Anaplasmosis	Babesiosis	Heartwater	Total cases
Arusha	786	3851	601	201	5439
Dar es salaam	103	51	17	21	192
Dodoma	962	2776	789	668	5195
Geita	394	547	226	373	1540
Iringa	848	948	303	94	2193
Kagera	1713	971	108	431	3223
Katavi	573	646	106	266	1591
Kigoma	1462	1348	186	210	3206
Kilimanjaro	395	1194	105	182	1876
Lindi	336	884	144	143	1507
Manyara	746	5153	931	894	7724
Mara	2729	3403	375	801	7308
Mbeya	1299	2106	497	197	4099
Morogoro	1867	1267	340	209	3683
Mtwara	146	278	27	179	630
Mwanza	2507	577	87	147	3318
Njombe	1449	1279	48	48	2824
Pwani	1812	2029	110	401	4352
Rukwa	1498	956	131	176	2761
Ruvuma	2568	1290	710	94	4662
Shinyanga	391	526	143	325	1385
Simiyu	724	853	208	488	2273
Singida	932	956	392	218	2498
Songwe	852	1048	430	100	2430
Tabora	1891	1043	303	345	3582
Tanga	2870	3941	1245	50	8106
Total cases	31853	39921	8562	7261	87597

DISCUSSION

This study assessed the effect of Government investment on tick control through dipping of cattle and TBD occurrence for the period of five and half years. The study revealed a significant increase in immersions of animals and a decreasing trend of mortality linked to TBD. The increase in number of animals exposed to tick control is a subject of investigation, However, in recent years there is a significant investment by the Government in control of ticks by rehabilitating and constructing new dip tanks together with subsidizing the cost of acaricides across the country. In addition, community participation in the management of dip tanks probably increased the dipping adherence and the sustainability of the program.

The two factors are likely to be the cause of the increase in number of animals and decrease in cattle mortalities related to TBDs. The use of acaricide through dipping is the most efficient tick control method in cattle. Historically, tick control in Tanzania started during the colonial era in 1905 when the first dip tank was constructed in Nungwe village in Mpwapwa District (Lynen *et al.*, 2007). After independence in 1961, dipping was 100% financed by the Government. The practice collapsed entirely in 1980s due to various factors including economic crisis (Nonga *et al*., 2012) and reforms on the delivery of veterinary services from public to private service provision. As a result, livestock keepers experienced increased

prevalence of TTBD and mortalities in cattle (Lynen *et al.,* 2007).

Government resumed construction and rehabilitation of dip tanks and supplied subsidized acaricides from 2006/2007 to 2013/2014 when the program collapsed again due to financial constrains (Mbassa *et al*., 2017, unpublished report). In 2018 the Government revitalized the efforts in control of TBD by rehabilitation and construction of dip tanks and supply of subsidized acaricides. This explains the increasing number of functional dip tanks and decreasing cases of TBDs observed in this study.

To ensure sustainability of the constructed dip tanks and service provision, community-led supervision approach was invented, and the Government formulated guideline for dipping stipulating responsibilities of each stakeholders including the central government through the Ministry responsible for livestock, regional offices, local government authorities (LGA), ward executive officers, village executive officers, dipping committees and livestock keepers.

The guideline was distributed to stakeholders during sensitization meetings at each level of administration. According to George et al. (2019) provision of acaricide subsidy as government support motivates livestock keepers to use the services available in the dip site including dipping their animals for TTBD control. In addition, the participation of livestock keepers in the control of TTBD through the dipping committees ensured sustainability of the practice. This also agrees with the findings by Peter *et al*. (2005) that when farmers are adequately engaged, they can contribute effectively in the control of TBD. The distribution of the recorded functional dip tanks covered all the regions of Tanzania although not proportional to the number of animals. Some regions had large number of functional dip tanks but with low cattle population as compared with other regions with fewer functional dip tanks but with high cattle population.

When the data was analyzed on the types of TBDs reported, Anaplasmosis was found to be reported more frequently followed by ECF. The cause of this differential reports of TBDs was not established as it was beyond the scope of this study. However, the extended distribution and adaptability of the tick vector (*R. microplus*) in the warm humid environment (Mamiro *et al.,* 2016) could favour some TBDs including Anaplasmosis. It is known that Anaplasmosis can be transmitted mechanically by other biting insects and thus increasing the chance of transmission of this disease compared to other TBDs. In addition, low distribution of infected ticks has been associated with low disease incidence for Babesiosis and Heartwater (Mamiro *et al.,* 2016). Furthermore, the temporal distribution of TBD cases appears to be throughout the year, though, the highest number of cases was observed during the rainy season. Rainy and hot seasons favor the multiplication and activity of the ticks as opposed to dry seasons. Also, the applied acaricide may be washed out during the rainy season and cause the acaricide to be ineffective (Nagagi *et al.*, 2020). Similarly, an increase in TBD during the rainy season is due to the increased abundance of ticks as previously reported (Chenyambuga *et al.*, 2010).

Furthermore, the distribution of TBDs covered all regions of Tanzania although with varying magnitudes. The wider distribution of TBDs suggests the wide spread of the vectors involved in the transmission of the diseases (Mamiro *et al.*, 2016). The distribution of TBD cases was noted to be highest in Tanga, Manyara and Mara regions. Livestock keepers in these regions are mostly pastoral communities, and share grazing areas, and therefore further increase of TBD vector transmission and spread of TBDs. These findings agree with the study by Mamiro *et al*. (2016) that in Tanzania ticks are distributed countrywide. The lowest distribution of TBD was reported in Dar es Salaam and Mtwara region which are characterized by low population of cattle. This is likely to change due to the fact that; pastoralists continue to relocate to these regions in search of pasture and other resources to support their herds.

In conclusion, the study shows that TBDs are still an obstacle facing the livestock sector in the country despite the positive progress made in TBD control. This implies that investment in controlling TBD should continue. However, the results should be

interpreted with care due to the fact that TBDs reported in this study was largely based on passive diagnosis and based on clinical signs. Despite of this limitation, the study provides an overview of the outcome of long-term investment in TBDs control

CONFLICT OF INTEREST

Authors have no conflict of interest on the issues presented in this article.

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