DEPARTMENT OF VETERINARY SERVICES

ZIMBABWE INTEGRATED TICK AND TICK-BORNE DISEASE CONTROL STRATEGY 2022 - 2030

SAFE FARM TO FORK
TRANSFORMING ZIMBABWE'S ANIMAL HEALTH AND FOOD SAFETY SYSTEMS

Government of Zimbabwe

ZAGP Zimbabwe AGRICULTURAL GROWTH Programme

Funded by the European Union

Food and Agriculture Organization of the United Nations

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This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of the Transforming Zimbabwe's Animal Health and Food Safety Systems (SAFE) project and do not necessarily reflect the views of the European Union.

1 EXECUTIVE SUMMARY

Zimbabwe's economy is agro-based with more than 65% of the population deriving their livelihood from agriculture and 40% of these doing so from livestock production. Livestock rearing is an integral part of the majority of the farming systems practiced in Zimbawe, particularly so in the small holder communal sector where livestock provide more than 80% of tillage in addition to being a cheap source of natural enrichment of the soil through manure for crop production. At the same time ruminant livestock utilize and convert crop residues and natural grazing into high quality protein for human nutrition. The livestock sector contributes 15 - 18% to the country's Agricultural GDP which in turn accounts for 21% of the national GDP and is set to increase to its contribution to the GDP to 25% by 2025 in line with the National Development Strategy 1 2021-2025 (NDS 1). The country's Livestock Growth Plan 2020-2025 identifies animal health as one of the key intervention points requiring urgent attention to correctly position the livestock sector for making meaningful contribution to NDS 1. Successful management of animal diseases will safeguard and protect investment in the other intervention points that have been identified which are genetics and nutrition as no amount of investment in these on their own can compensate for unhealthy animals.

Currently, livestock farming in the small holder communal sector, which holds more than 90% of the national herd, is characterized by low conception rates, low growth rates, high mortalities, poor carcass quality and limited market access. Improved livestock disease management is key in addressing these drawbacks as the country drive towards transformation of this important economic sector. Diseases that are transmitted by ticks, commonly known as tick-borne diseases (TBDs) rank highest on the list of diseases of concern to livestock in both the small holder communal sector and large scale commercial sector in Zimbabwe. Four tick-borne diseases (Theileriosis, basesiosis, anaplasmosis and heartwater) are of major concern to the ruminant livestock farmers as they can cause high morbidity and mortality and consequently result in high production loses. These four diseases account for over 60% of ruminant livestock disease mortalities recorded by the DVS. It is therefore imperative that Zimbabwe enhances its capability to fight these diseases as part of the effort to develop a lasting solution to challenges preventing the livestock sector from realizing its full potential.

Regulated tick control through compulsory dipping of cattle was introduced in the country in 1901 in response to massive livestock deaths resulting from East Cost Fever (ECF), a form of theileriosis that had been introduced in the country through imports of cattle from East Africa following the 1989 rinderpest outbreak. Compulsory short interval dipping of cattle was introduced in 1914 held the country eradicate

ECF in 1950. Since then tick and tick borne disease control has remained one of the mandates of the Department of Veterinary Services. Delivery of this mandate has faced different challenges over the years and the approaches have been evolving with changes in operating environment. Development of this strategy was necessitated by the recently experienced upsurge in livestock mortalities attributed to TBDs in the past few years and the need to come up with a sustainable long term solution to the scourge.

In order to ensure the strategy is relevant and fit for purpose, its development went through a rigorous process which started with conducting an in depth desk review of the tick-borne disease trends in recent years (2014-2019) using officially validated animal health data from the DVS database. From the desk study it was clear there was a sharp increase in TBDs cases of the four major TBDs for the period 2014-2020 compared to the preceding years. A major contributor to this upsurge was a significant reduction in acaricide supply for the DVS due to a variety of reasons, major among which was the shortage of foreign currency to import raw material. Theileriosis was the biggest challenge followed by heartwater which also showed higher case-fatality rates than anaplasmosis and babesiosis.

A careful analysis of the current TBDs control approaches being implemented in Zimbabwe were compared and contrasted with those of other countries in the region, evaluating them effectiveness and possible shortcomings. Results of the evaluation indicated that the approach is most countries was more or less the same, anchored chemical control of the tick vector. However, in the other regional countries, to a large extent farmers from all the livestock sectors: large-commercial, small-holder and traditional, purchase their own acaricides and manage the application on their own with very minimal supervision from the veterinary authority. The uncoordinated chemical control of ticks in most of these countries has also led to a much more pronounced emergence of acaricide resistance, particularly in the small-holder sector. In Zimbabwe the DVS involvement in the acquisition and application of acaricides for the small holder communal sector for over a century largely contributed to a high quality of acaricides usage hence the delay in development of acaricide resistance in the country as compared to its neighbors.

The initial draft strategy produced was presented and debated at a technical validation workshop comprising of representatives of both public and private veterinary services. Input from this technical validation workshop was incorporated to produce the second draft from which the final draft was produced after gathering additional contribution from 2 stakeholder validation workshops, one for the northern region and the another for the southern region.

Going forward Zimbabwe will continue with strategic use of acaricides as the main method of managing exposure of ruminant livestock to ticks with plunge dipping being the preferred application method. Plunge dipping has over the years been proven to be the most effective and economic method of controlling ticks and other external parasites of ruminants. Other acaricide application methods which include mechanized spray races, and use of pour-on formulations will also be employed in circumstances where their use is more convenient over plunge dipping in line with locally prevailing circumstances. Tick grease hand dressing is only recommended as complementary to the other methods to the main acaricide application methods. The DVS will continue to regulate and provide direction on the use of acaricides in the country in close consultation with other key stakeholders in the livestock industry, paying particular attention to ensuring maintenance of TBD enzootic stability of the national herd.

The government, through its network of over 4000 dip tanks, will continue to manage cattle dipping in the smallholder sectors. This will be done with increased active participation of the small holder farmers meant to benefit from this infrastructure as they get empowered with the necessary knowledge and skills to do farming as business and thrive on their own with minimal support from government. Use and management of acaricides in the large scale farming sectors will remain in the hands of the individual farming entities with provision of monitoring, regulatory and advisory services being provided by DVS.

In addition to the chemical control methods the government will also support and promote the development and use of efficacious TBD vaccines to ensure adequate levels of immunity in susceptible herds. The tick borne disease vaccine production unit at CVL will continue to support to research and development of appropriate TBD vaccines with the ultimate aim of handing over the commercialization to the proven technology to competent private sector partners.

Since the tick vector cannot move long distances on their own, their movement from one area to another together with the pathogens they carry is through movement of the host animal. Movement of tick infested livestock is therefore the main driver of tick-borne disease spread from one area to another. Strict enforcement livestock movement control regulations will therefore be an integral component of this strategy with level of tick infestation being one of the criteria to be considered before issuing of movement permits by the DVS. .

The government will, through DVS, maintain updated, relevant supportive legislation to facilitate investment by value chain players towards and effective implementation of the different facets of the strategy. Research by both the public and private sectors in the various areas related to tick borne

diseases and their management will also be mainstreamed as a key facet of this strategy to facilitate evidence-based decision making taking into consideration locally adapted solutions to emerging challenges.

2 INTRODUCTION

2.1 EPIDEMIOLOGY OF TICKS AND TICK-BORNE DISEASES

Ticks and the tick-borne diseases (TBDs) they transmit remain a major constraint to livestock production in Zimbabwe. The most important TBDs and their vectors are summarised in Table 1. In southern Africa, the vector ixodid ticks have a seasonal occurrence whereby adults are most abundant in the rainy season when the weather and other environmental conditions are ideal for their activity and survival of the desiccation-sensitive eggs whilst the immatures are predominant in the post-rainy season to dry season. Since adult forms are more efficient vectors of pathogens than the immature (larvae and nymphs) , most TBDs occur in the rainy season when adults are at their peak. The seasonal trends tend to be more pronounced for the 3-host ticks (e.g. *Rhipicephalus appendiculatus*, *Amblyomma* spp.) which spend prolonged periods in the environment than for the 1-host ticks (e.g. *Rhipicephalus Boophilus decoloratus*) and 2-host ticks (e.g. *R. evertsi evertsi*), which spend a significant time on-host. For the 1-host and 2-host ticks, mature and immature forms have been collected from animals all year round.

Table 1: Major ticks and tick-borne pathogens (diseases) in Zimbabwe

Pathogen (diseases) transmitted	**Livestock affected**	**Main vector tick**		
		Scientific name	**Common name**	**Tick type**
Theileria parva (January disease and Corridor disease)	Cattle	*Rhipicephalus* (*R*) *appendiculatus*	Brown ear tick	3-host
		R. zambeziensis (3 -host tick)	Lowveld brown ear tick	3-host
Babesia bigemina (Redwater)	Cattle	*Rhipicephalus Boophilus* (*R. B.*) *decoloratus*	African blue tick	1-host
		R. B. microplus	Asiatic/Coastal tick	1-host
Babesia bovis (Cerebral babesiosis)	Cattle	*R. B. microplus*		
Anaplasma marginale (Gallsickness)	Cattle	*Rhipicephalus Boophilus* spp.	Blue ticks	1-host
Ehrlichia ruminantium (Heartwater)	Cattle, Goats, Sheep	*Amblyomma* spp. mainly *A. hebraeum* & *A. variegatum*	Bont ticks	

Distribution of the TBDs in the country follows that of their vector ticks. Classical redwater, caused by *Babesia bigemina*, and gallsickness occur throughout the country because of the widespread distribution of *R. Boophilus decoloratus*. Heartwater and its vectors presently occur in all provinces. In the early years of independence (1980-85) after the reintroduction of intensive dipping, heartwater receded to the

southern and lowveld endemic areas after its previous spread onto the central highveld during the war of independence (1975-1980) (Norval et al., 1994). Reports and diagnosis of highveld cases of the disease and the vectors reappeared as from 1986 (Peter et al., 1998) and, since then, have spread unabatedly. Spread was partly due to relaxation in movement of wildlife and unrestricted movement of small stock. Theileriosis parva is largely confined to particular foci on the high- to middle-veld with adequate vegetation cover for the survival of the tick vectors, abundance of suitable susceptible (to both the tick and *Theileria parva*) hosts and inadequate tick control. Most of these theileriosis cases are January disease (cattle-to-cattle transmission) whilst sporadic Corridor disease (buffalo-to-cattle transmission) outbreaks occur in areas with the Cape buffalo, *Syncerus caffer*. *Babesia bovis* infection and its tick vector, *R. B. microplus* are not common in Zimbabwe. The tick vector is established in pockets in the northwest and along the eastern border of Zimbabwe (DVS national tick survey, 1995; 2013) and evidence of infection has been found in cattle in these areas (Katsande et al. 1996; Smeenk, 2000). Recent survey data also recorded the ticks in inland areas, some of them on the highveld (DVS national tick survey, 2013), and sporadic cases of *B. bovis* infection were confirmed (CVL, unpublished data). Spread of this tick is of concern as it spreads *B. bovis* infection which often causes an acute cerebral syndrome in naïve cattle characterised by very high fatality-rates.

2.2 RELEVANCE OF TICKS AND TICK-BORNE DISEASE CONTROL TO AGRICULTURE IN ZIMBABWE

The majority (>70%) of the Zimbabwean population depends on agriculture for a livelihood. Livestock keeping remains an integral part of the rural/farming communities, with cattle and goats as the predominant species. Traditionally, the main functions of cattle are provision of draught power for tillage and transport, provision of manure, milk for domestic consumption and sale, meat and other by-products for domestic consumption and local sale, investments and savings of household finances, and social for ritual purposes and display of social status (Barrett, 1992). Goats and sheep, on the contrary, are readily sold to meet the recurrent cash needs for the household (Chilonda, 1996). The agrarian reform programme redistributed land from former large farms and estates, as well as state land into smaller units given to more farmers under two models, A1 and A2 (Moyo, 2011). According to the country's Zimbabwe Comprehensive Agricultural Policy Framework 2012-2032, most of the national ruminant livestock is now in the hands of A1, A2, Communal, Resettlement and Small-scale farmers combined. The 2019/20 livestock census estimates were at 5,774,525 for cattle, 4,360,838 for goats and 522,955 for sheep and 90%, 99% and 80% of cattle, goats and sheep, respectively, are owned by these farmers (Zimbabwe Livestock Growth Plan, 2020). However, most of these livestock-rearing units remain subsistent, resource-poor, low-input and low-technology, hence the low productivity and subsequent low

income. Outbreaks of specified animal diseases, which include TBDs, further affect the already low productivity, value additions and market access and trade. In order to position the smallholder livestock sector in its correct place as one of the key drivers of the ongoing agricultural sector transformation, there is need to put in place a well-articulated strategy to combat the negative impact of tick-borne diseases on ruminant livestock production.

2.3 HISTORY OF TICKS AND TICKBORNE DISEASE (TBD) CONTROL IN ZIMBABWE

Before introduction of East Coast fever (ECF), caused by *Theileria parva*, in 1901 dipping was done every 10-14 days to control outbreaks of babesiosis and anaplasmosis (transmitted by *Boophilus*[1] ticks) in primarily the exotic cattle (Theiler, 1905). The principal *T. parva* tick vector, *Rhipicephalus appendiculatus*, was already widespread in the country and region but without association with any disease. Its role in transmission of ECF was first described by Lounsbury (1904), Theiler (1905, 1908) and Gray (1908). Compulsory short interval dipping, done every 7 days in high-risk areas and increased to every 3-5 days in areas with outbreaks, was introduced in 1914 with the aim of eradicating the vector of East Coast fever (ECF) (Norval et al., 1992). The short interval dipping on its own did not manage to eliminate or eradicate the brown ear tick. Southern African regional veterinary authorities then resolved to supplement the short interval dipping with surveillance of cattle movements, quarantine and slaughter policies (Anon, 1929). Zimbabwe eradicated the classical ECF in 1954. However, the country saw the emergence of two other forms of cattle *T. parva* theileriosis, a cattle-derived form named January disease, that was much easier to manage, and the buffalo-derived Corridor disease. The two have persisted to date with babesiosis (mostly due to *Babesia bigemina*), anaplasmosis and heartwater, a disease of cattle and small ruminants, the latter having been first introduced from South Africa in the early 1900s.

Intensive dipping remained the cornerstone of TBD control in both the commercial and traditional livestock sector and in the latter, the DVS continued to finance, acquire the chemicals and supervise the process. In the course of history, the country has experienced disruptions in the dipping programs. For instance, during the war of independence there were reports of increased TBD outbreaks in communal land areas due to interruptions in tick control which led to the loss of 1 million cattle, a third of the national herd (Norval, 1979). Serosurveys conducted in the early years of independence demonstrated enzootic stability to TBDs in these areas most of which had experienced dipping disruptions for extended periods (Norval, 1981; Norval et al., 1983; Norval et., 1984; Norval et al., 1985). After 1985, theileriosis outbreaks were on the increase on commercial farms where the tick vectors occurred despite intensive dipping

[1] Now reclassified as a subgenus within the Genus *Rhipicicephalus*

(Koch, 1990). Cases of Corridor disease became common in the 1990s on the highveld due to the introduction of Foot and Mouth virus-free Cape buffalo onto small game reserves (Latif et al., 2002).

By the mid1980s, Zimbabwe and other countries in East, Central and Southern Africa had accepted that intensive tick control as a means of preventing TBDs was unsustainable due to aspects such as increasing costs of chemicals, shortage of foreign exchange, rundown dipping facilities and development of acaricide resistance by the ticks. Intensive chemical tick control also created enzootically unstable situations where cattle, particularly the exotic breeds and their crosses, were left very vulnerable to TBDs. A joint FAO/DANIDA regional program commenced in 1989 with the objective of developing a cost-effective sustainable control strategy for ticks and TBDs in the region, which promoted enzootic stability. Development of TBDs vaccines, particularly the *T. parva* one centrally produced at a regional location, tested in large-scale field immunization trials in individual countries, was a major component of the strategy. Zimbabwe already produced babesia and anaplasma vaccines and opted to produce its own cattle-derived *T. parva* vaccine. By the mid-1990s, the Central Veterinary Laboratory (CVL) had produced and field-tested a *T. parva* vaccine which could be administered without oxytetracycline therapy (which reduced the cost substantially) with DANIDA/FAO assistance (Kanhai et al., 1997). The quality of the *Babesia* and *Anaplasma* vaccines was improved, and they were field tested with the assistance from the Australian government (Madzima and Mutugi, 1979). However, there was no locally produced *Ehrlichia ruminantium* vaccine.

3 TICK-BORNE DISEASES TRENDS IN RECENT YEARS (2014 -2020)

3.1 TICKBORNE DISEASE TRENDS (2014-2020)

According to the World Organisation for Animal Health (OIE) (2021), the collection, verification and publishing of official health information following a standardised process to ensure high quality data is in the hands of the DVS of member countries. Thus, data used here was obtained from an amalgamated national animal disease reports database compiled by the DVS. There were however very strong sentiments from many of the stakeholders who participated in the both the technical and general stakeholder validation workshops that the official absolute numbers of TBD cases captured by the DVS indicate a very high level of under reporting of TBD cases as the situation on the ground was much worse than what the database was showing. Comparison of TBDs trends for the period 2014-2020 and those from a previous study for the period 1995-2005, using, indicated a substantial increase in cases of the four major TBDs for the period 2014-2020 (Figure 1). A major contributor to this upsurge was a significant reduction in acaricide supplies for the department (Data not shown). The cases/fatalities for each of the

TBDs are summarised in Tables 2-7and Figures 2-7. Theileriosis occurred in a few specific foci which most likely had the ideal environment for the survival of brown ear tick vector, with an alarming rise in cases in 2019. In 2020, there was a notable increase of theileriosis cases in the provinces of Mashonaland Central, Masvingo and Midlands in comparison to 2019. Theileriosis was very rare in both Matabeleland South and North provinces, more so in the former. The main TBD reported from the Matabeleland provinces was heartwater. Overall, theileriosis followed by heartwater had higher case-fatality rates than anaplasmosis and babesiosis. Heartwater also caused loss of a noticeable proportion of affected bovines and small ruminants which cannot be ignored. Although the amblyomma vectors of the disease have spread widely and are established on parts of the highveld, the current data and recent experiences (Makuvadze et al., 2020) suggested that the ticks were still not well established in Mashonaland Central province (Tables 5 & 6) and parts of Mashonaland East which border that province. The database did not distinguish between *Babesia bigemina* and *B. bovis* cases. *Babesia bovis* is not common in Zimbabwe, hence most cattle are likely to be very susceptible to it. The acute form of the disease is also characterised by a cerebral syndrome which often results in a more serious condition with very high fatality rates, hence the importance of laboratory diagnosis to distinguish between these two babesias. Previous studies (Katsande et al., 1996), including the 2012-2103 DVS national tick survey, have indicated the inland spread of the tick vector, *Rhipicephalus Boophilus* (*R. B.*) *microplus*, from foci where it is common along the eastern border and southern part of Lake Kariba in the northwest of the country. The data also indicated an emerging problem of small ruminants anaplasmosis caused by *Anaplasma ovis* (Table 3 & Figure 3).

Figure 1: Pooled annual tickborne disease cases for the periods 1995-2005 & 2014-2020

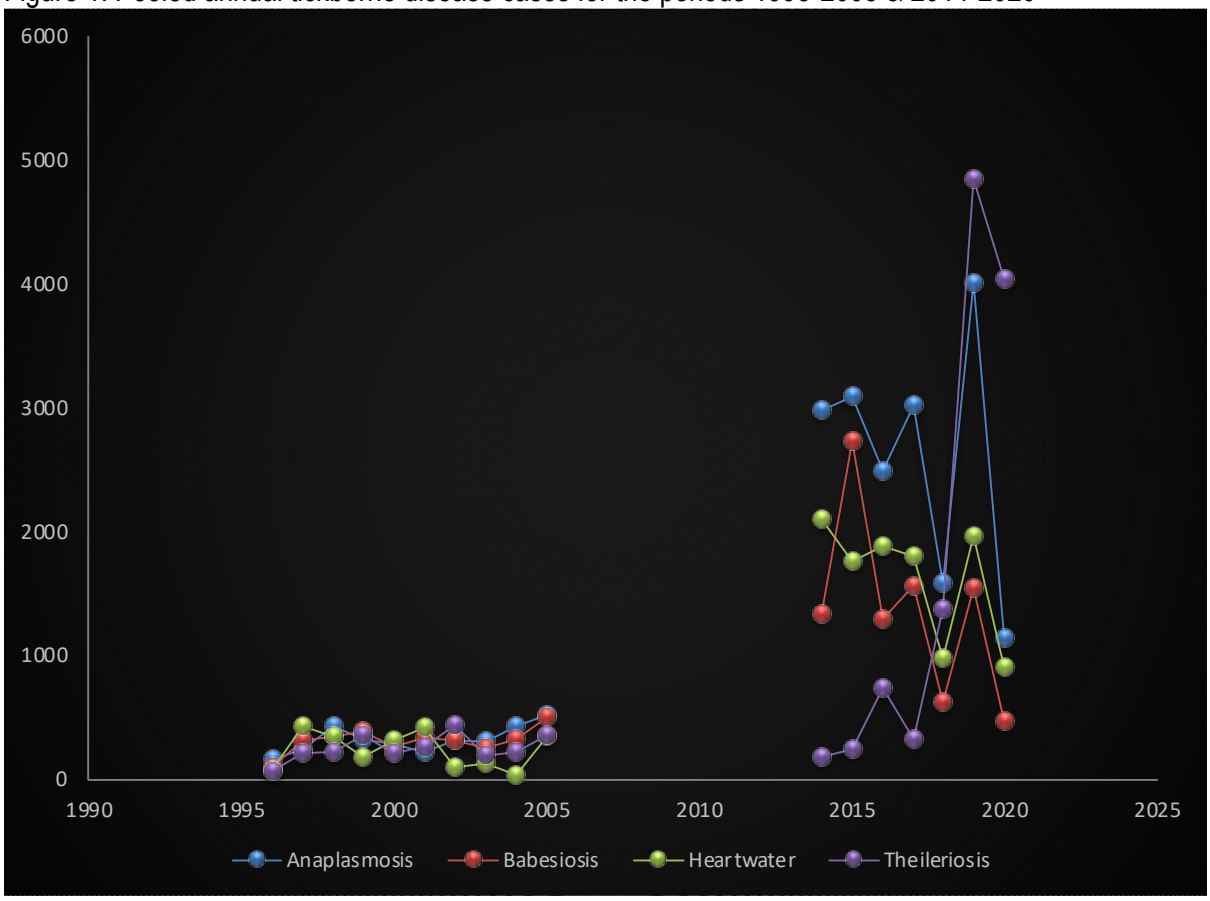


Table 2: Annual bovine anaplasmosis cases/deaths per province (2014-2020)

Province	Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019		Year 2020		Total	
	cases	deaths	cases	deaths	cases	Deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Manicaland	748	158	737	129	424	105	916	100	350	69	354	64	248	54	**3777**	**679**
Mashonaland Central	287	57	278	55	291	48	394	103	38	5	46	7	231	49	**1565**	**324**
Mashonaland East	327	40	764	107	515	63	447	38	360	49	78	11	22	9	**2513**	**317**
Mashonaland West	2975	596	475	100	422	81	377	99	116	32	675	110	150	21	**5190**	**1039**
Masvingo	206	45	313	64	367	90	350	93	96	33	2240	108	88	32	**3660**	**465**
Matabeleland South	86	44	50	23	67	30	52	18	25	8	182	96	84	29	**546**	**248**
Matabeleland North	124	44	99	52	121	74	101	63	84	18	63	16	87	50	**679**	**317**
Midlands	1004	93	370	77	283	33	384	126	513	99	374	73	219	46	**3147**	**547**
Total	**5757**	**1077**	**3086**	**607**	**2490**	**524**	**3021**	**640**	**1582**	**313**	**4012**	**485**	**1141**	**292**	21089	3938

Figure 2: Pooled annual bovine anaplasmosis cases/deaths (2014-2020)

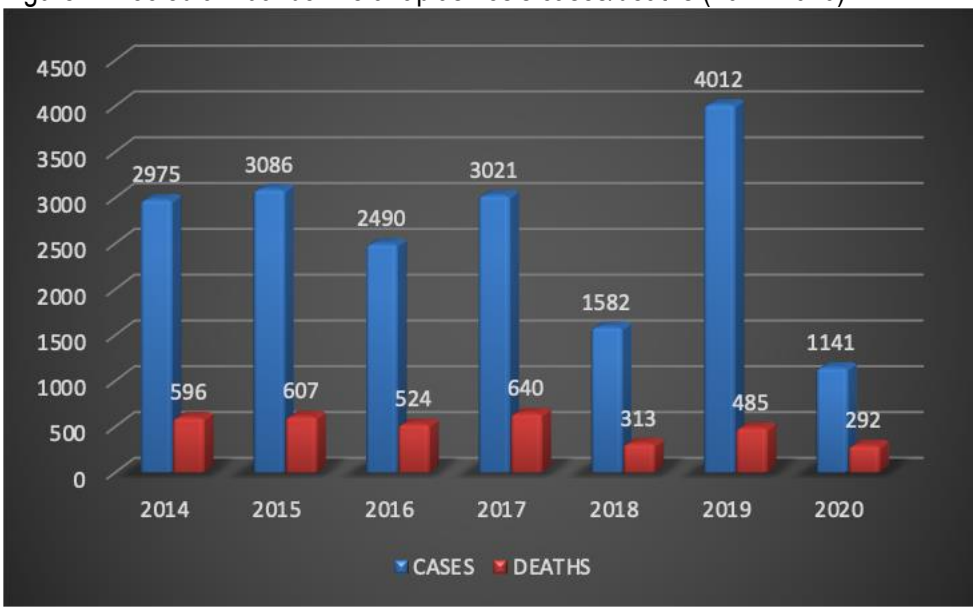


Table 3: Annual small ruminant anaplasmosis cases/deaths per province (2014-2019)

Province	Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019		Total	
	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Manicaland	6	3	13	4	7	3	5	3	0	0	0	0	**31**	**13**
Mashonaland Central	0	0	1	0	1	0	0	0	0	0	0	0	**2**	**0**
Mashonaland East	3	2	28	2	1	0	3	0	0	0	0	0	**35**	**4**
Mashonaland West	0	0	6	3	4	2	3	2	0	0	0	0	**13**	**7**
Masvingo	1	0	44	7	37	5	9	5	5	4	3	0	**99**	**21**
Matabeleland South	1	0	0	0	4	1	4	0	0	0	9	5	**18**	**6**
Matabeleland North	1	1	10	4	1	0	1	1	1	0	1	1	**15**	**7**
Midlands	2	1	2	0	18	8	20	13	6	2	16	7	**64**	**31**
Total	**14**	**7**	**104**	**20**	**73**	**19**	**45**	**244**	**12**	**6**	**29**	**13**	277	89

Figure 3: Pooled annual small ruminant anaplasmosis cases (2014-2019)

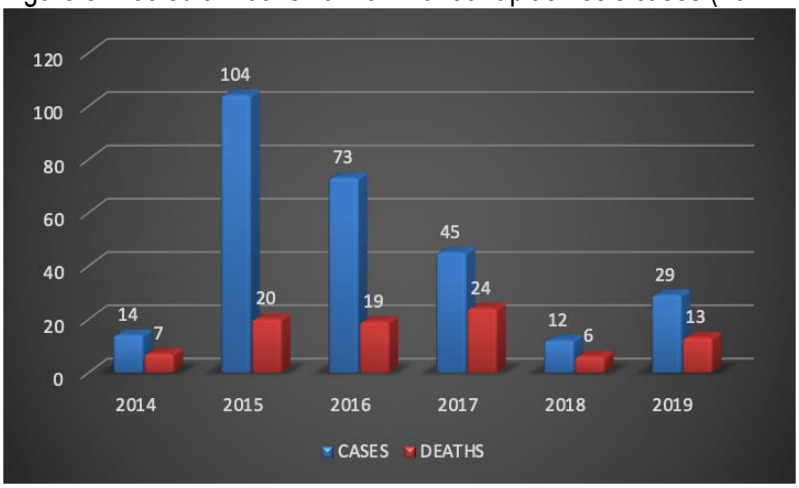


Table 4. Annual bovine babesiosis cases/deaths per province (2014-2020)

Province	Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019		Year 2020		Total	
	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Manicaland	402	75	329	63	189	22	502	82	154	24	134	22	82	20	**1792**	**308**
Mashonaland Central	191	20	178	25	187	25	234	35	27	4	30	5	145	32	**992**	**146**
Mashonaland East	167	38	333	48	212	28	225	38	179	19	47	8	5	1	**1168**	**180**
Mashonaland West	276	71	308	61	296	25	313	61	103	31	1016	29	115	14	**2427**	**292**
Masvingo	146	28	1435	28	140	14	182	33	43	8	235	52	47	7	**2228**	**170**
Matabeleland South	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**
Matabeleland North	17	6	50	20	220	32	39	14	6	2	17	3	6	2	**355**	**79**
Midlands	134	17	91	10	51	4	67	20	115	11	61	7	68	12	**587**	**81**
Total	**1334**	**255**	**2724**	**255**	**1295**	**150**	**1562**	**283**	**627**	**99**	**1540**	**126**	**468**	**88**	9550	1256

Figure 4: Pooled annual bovine babesiosis cases/deaths (2014-2020)

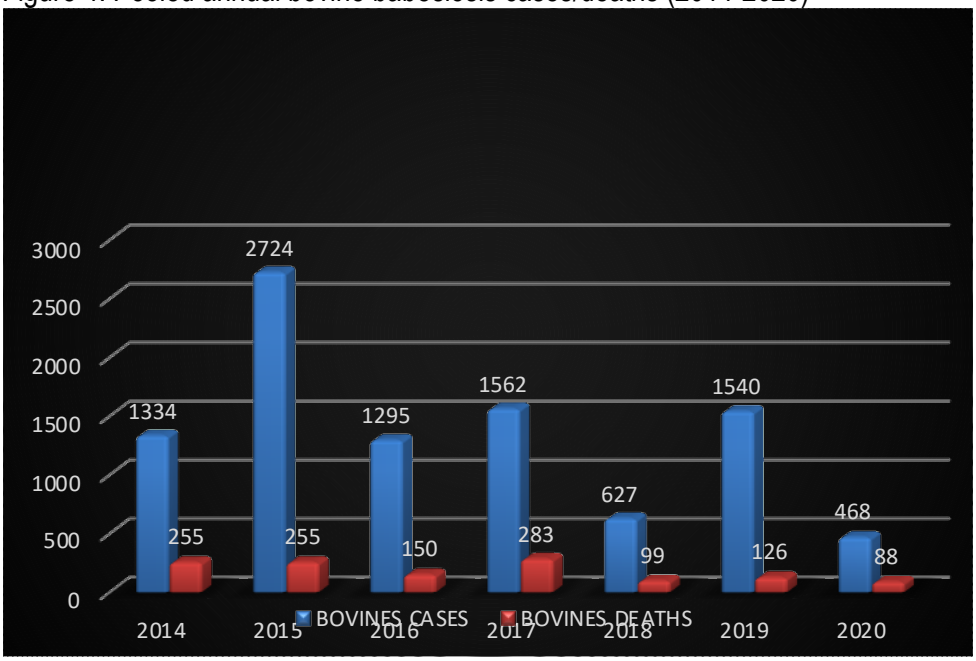


Table 5: Annual bovine heartwater cases/deaths per province (2014-2020)

Province	Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019		Year 2020		Total	
	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Manicaland	409	113	303	118	235	88	456	142	130	38	232	45	127	30	**1892**	**574**
Mashonaland Central	10	0	4	0	0	0	7	2	1	0	0	0	4	3	**26**	**5**
Mashonaland East	205	58	233	58	174	43	101	37	100	25	23	7	6	0	**842**	**228**
Mashonaland West	300	67	342	97	402	167	269	136	105	31	217	62	207	24	**1842**	**584**
Masvingo	546	191	315	114	476	173	439	140	76	24	507	131	122	51	**2481**	**824**
Matabeleland South	193	58	104	41	189	79	164	63	60	25	440	210	137	63	**1287**	**350**
Matabeleland North	102	52	167	78	195	99	117	42	19	9	133	76	88	54	**821**	**410**
Midlands	339	115	289	81	217	86	247	106	482	156	409	135	207	96	**2190**	**775**
Total	**2104**	**654**	**1757**	**587**	**1888**	**735**	**1800**	**668**	**973**	**308**	**1961**	**666**	**899**	**322**	11382	3940

Figure 5: Pooled annual bovine heartwater cases (2014-2020)

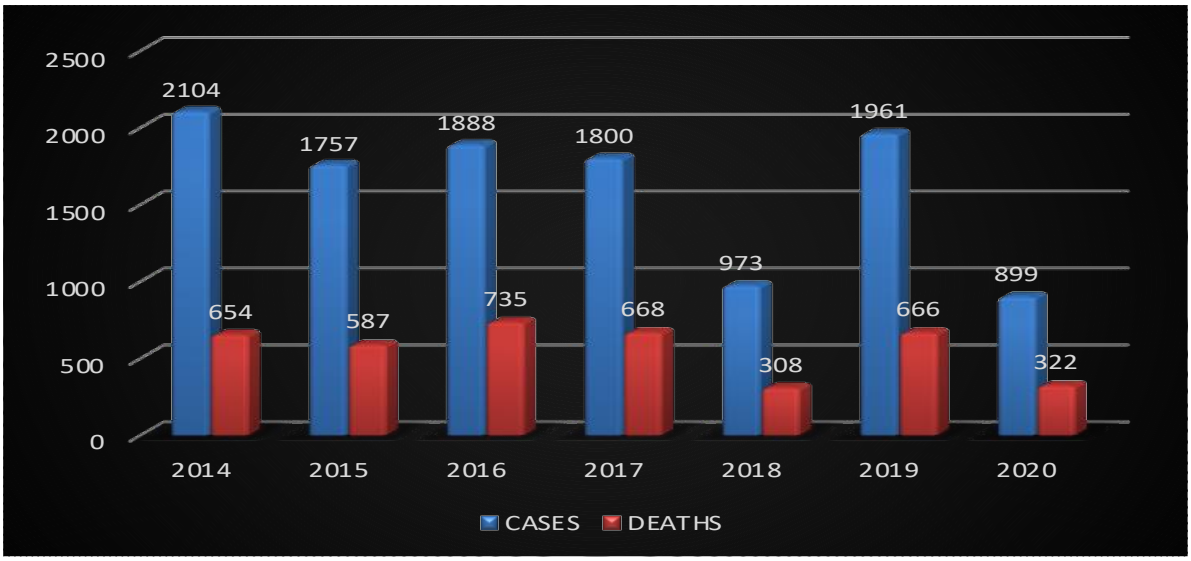


Table 6: Annual small ruminant heartwater cases/deaths per province (2014-2020)

Province	Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019		Year 2020		Total	
	cases	deaths	cases	deaths	cases	Deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Manicaland	300	91	297	79	219	63	293	132	85	39	74	13	139	15	**1407**	**432**
Mashonaland Central	0	0	1	0	0	0	13	10	0	0	0	0	0	0	**14**	**10**
Mashonaland East	21	3	57	15	20	10	111	38	6	1	8	0	0	0	**223**	**67**
Mashonaland West	8	4	77	20	80	21	161	74	4	2	9	6	9	2	**348**	**129**
Masvingo	161	48	153	59	363	106	230	92	34	19	152	62	31	13	**1124**	**399**
Matabeleland South	108	42	79	41	118	67	82	48	16	10	116	63	139	75	**658**	**346**
Matabeleland North	65	43	91	37	64	32	304	31	9	2	11	8	24	12	**568**	**165**
Midlands	59	15	122	32	98	28	77	40	266	120	54	26	20	6	**696**	**267**
Total	**722**	**246**	**877**	**283**	**962**	**327**	**1271**	**465**	**420**	**193**	**424**	**178**	**362**	**123**	**5129**	**1815**

Figure 6: Pooled annual small ruminant heartwater cases/deaths (2014-2020)

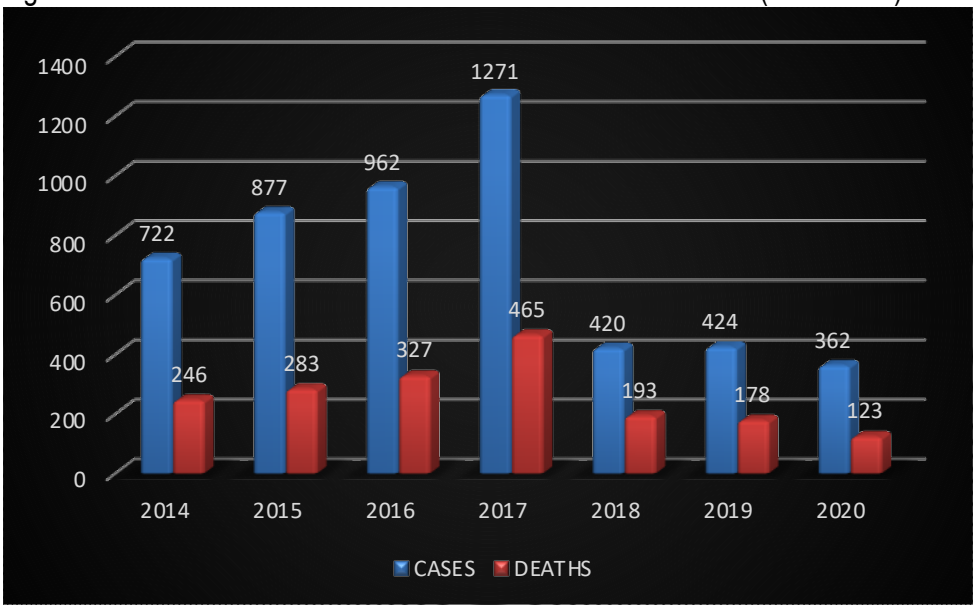
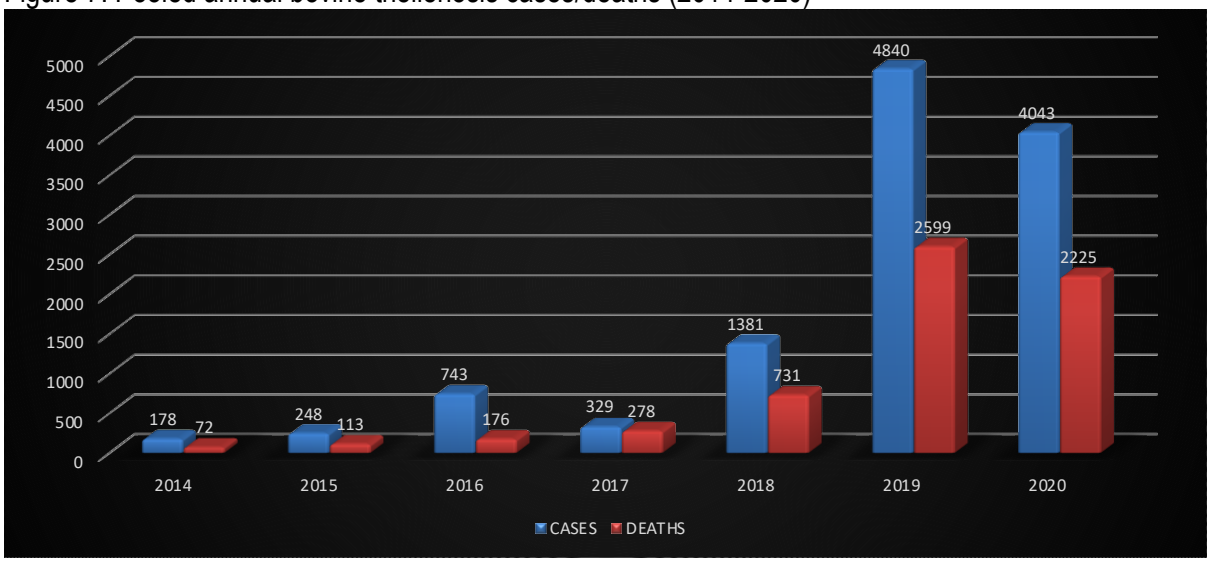


Table 7: Annual bovine theileriosis cases/deaths per province (2014-2020)

Province	Year 2014		Year 2015		Year 2016		Year 2017		Year 2018		Year 2019		Year 2020		Total	
	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Manicaland	99	45	75	41	18	3	72	20	80	15	280	150	631	317	**1255**	**591**
Mashonaland Central	0	0	0	0	1	0	34	29	21	11	430	327	1897	1231	**2383**	**1598**
Mashonaland East	33	11	44	6	27	14	134	53	543	294	137	45	66	12	**984**	**435**
Mashonaland West	16	0	18	9	27	1	53	58	175	62	3728	1892	348	150	**4365**	**2172**
Masvingo	23	11	109	57	647	151	35	118	178	151	204	162	876	445	**2072**	**1095**
Matabeleland South	0	0	0	0	0	0	0	0	0	0	1	1	0	0	**1**	**1**
Matabeleland North	1	0	2	0	21	7	1	0	0	0	0	0	3	3	**25**	**7**
Midlands	6	5	0	0	2	0	0	0	384	198	60	22	288	82	**740**	**307**
Total	**178**	**72**	**248**	**113**	**743**	**176**	**329**	**278**	**1381**	**731**	**4840**	**2599**	**4043**	**2225**	**11762**	**6194**

Figure 7: Pooled annual bovine theileriosis cases/deaths (2014-2020)



3.2 ESTIMATED VALUE OF ANNUAL LOSSES FROM TBDS

Quantification of the total financial cost is critical in the demonstration of the magnitude of the TBDs problem to policy makers and possible donors. However, it is a daunting task performed by economists using the available multiple data on these diseases which in developing countries are often deficient in quantity and quality. Such economic estimates of losses due to TBDs are scarce and those few have focused on cattle.

Mukhebi *et al*. (1992) estimated the average losses due to *T. parva* in 11 central, eastern, and southern African countries (including Zimbabwe) for the year 1989. Of the total (100%) loss, beef loss accounted for 12.24 %, milk loss 46.73 %, animal traction loss 12.68 %, manure loss 0.04 %, treatment 4.82 %, acaricide application 19.6 % and research and extension 3.89 %. Manure loss was negligible. The overall cattle mortality in these countries was 1.1 million cattle and the economic loss was ~ USD 168 million. The theileriosis loss per cattle head was USD 7.02 and that per cattle hectare was USD 1.08.

Assessment of the economic impact of heartwater and its control in Zimbabwe under a scenario whereby heartwater and its vectors would continue to spread to cover the entire country estimated annual losses which amounted to USD 5.6 million for 1995 (Mukhhebi et al., 1999). At that time the components (out of 100% in each case) of the annual discounted economic losses for the two main production systems were as follows:

- Communal: beef loss 1.5%, milk loss 36%, traction loss 0.2%, manure loss 0.5%, acaricide cost, 61% and treatment cost 0%
- Commercial: beef loss 0.1%, milk loss 16%, traction loss 0%, manure loss 0%, acaricide cost 78% and treatment cost 6%

The main costs in both sectors were due to acaricide supplies and milk loss whilst treatment loss was only associated with the commercial sector. Production losses due to beef, manure and traction were minimal. The annual economic loss per animal was USD 0.2 and USD 5.09 for the communal and communal sectors, respectively.

More of such studies which take into consideration small ruminants were applicable and transformations in the land distribution are needed.

4 CURRENT SITUATION ANALYSIS (2021)

4.1 INSTITUTIONAL SET UP

The Department of Veterinary Services (DVS) falls within the Ministry of Lands, Agriculture, Fisheries, Water and Rural Development (LAFWRR). It is headed by a Principal Director who reports to the Permanent Secretary in the Ministry. The department has three divisions, each headed by a Divisional Director: Tsetse Control, Veterinary Technical Services and Veterinary Field Services. The Division of Tsetse control deals with control of the tsetse fly, vector of trypanosomiasis whilst the Divisions of Veterinary Field Services and Veterinary Technical Services oversee the control and prevention of animal diseases and the other animal pests, which include tick-borne diseases (TBDs) and ticks. Field Services has 8 Provincial Veterinary Offices, 60 District Veterinary Offices and 800 Animal Health Management Centres and it implements the vaccination programmes, dipping, movement control and animal identification and disease surveillance. Veterinary Technical Services is divided into the Public Health Branch whose function is to protect consumers from diseases transmitted from animals and animal products to man and also protects the country borders from entry of such through importation of animals and animal products and the Diagnostic and Research Branch which carries out the laboratory diagnosis of diseases, vaccine production and animal health research.

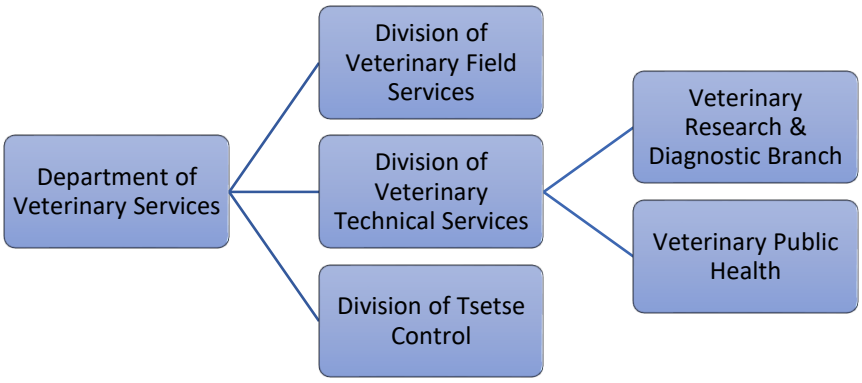


FIGURE 8: DEPARTMENT OF VETERINARY SERVICES ORGANOGRAM

4.2 LEGAL FRAMEWORK FOR TBD CONTROL

The department derives its mandate mainly from the Animal Health Act [*Chapter 19:01*], which provides under Section 5, for the eradication and prevention of the occurrence or spread within Zimbabwe and for the prevention of the introduction into Zimbabwe of animal diseases and pests. Some of the promulgated regulations within the Act that have some relevance to control of ticks and TBDs are:

- **Animal Health (Cattle-Cleansing) regulations** regulate the control of the tick vectors for TBDs and is a corner stone to TBDs disease management. These regulations define terms such as dipping

tank/spray race, engorged tick, specified tick genera, cattle deemed to be tick-infested, orders such as quarantine of tick-infested animals, frequency of dipping in wet and dry seasons, the obligation for owner to stick to a specific communal diptank, specifications for dipwash in use, maintenance of sufficient supplies of dipping chemical, restriction on movement of cattle, records of animals dipped and taking of samples prior to dipping for analysis at each session.

- **Animal Health (Stock Register) Regulations** requires the registration of every bovine animal which is presented for dipping and other purposes in a stock register kept by an authorized person and the owner obtains a stock card with all registered cattle. Any movements, additions, removals, births and deaths should be recorded within 14 days.
- **Animal Health (Movement of Cattle and Pigs) Regulations** prohibit the of movement of cattle and pigs without a permit and some aspects considered for cattle, for instance, are the absence of ticks and symptoms of TBDs.
- **Animal Health (Movement of Game Animals) Regulations**: States the specifications for movement of wild game animals and permits are required for that purpose. The regulation is important in the trekking the movement and location of Cape buffalo, reservoir of *T. parva* and important host for the vector ticks, in the country.
- **Animal Health (Theileriosis) Regulations** govern movement or straying of animals and infectious things from an area defined as "theileriosis area' by the Minister or authorized person without a permit and animals being moved must comply with specified dipping/spraying requirements and other specifications of the Cattle-Cleansing regulations, suspected deaths due to theileriosis should be reported to DVS within a specified time and specimens should submitted for confirmation. Animals in the specified area are subject to inspection and counting by an authorized person.
- **Animal Health (Import) Regulations**: in relation to TBDs, only allow the importation of animals (cattle) or infectious things originating from an area which has been free from East Coast fever during the three years prior to the date the certificate is signed.
- Section 5: 17 and 18, also provides for control the import, manufacture, advertising, sale, issue, distribution, use and disposal of medication, animal feed, vaccines, diagnostic products and pest-destroying agents. All this also applies to remedies used in the management of ticks and TBDs such as acaricides, treatment for TBDs, vaccines and diagnostic reagents and products.

Other Acts which regulate aspects such as the import, manufacture, advertising, sale, issue, distribution, use and disposal of products for ticks and TBDs control and management are:

- **The Medicines and Allied Substance Act Control (General) Regulations** which require stock remedies and vaccines available with or without a prescription to be registered for local use by the Medicines Control Authority of Zimbabwe (MCAZ). The latter authority grants a license which also considers other aspects such as storage, safe keeping in-store or in-transit and adequate labelling.
- **The Veterinary Surgeons Act** and **the Veterinary Surgeons (Veterinary Laboratories) Regulations**:

- The Veterinary Surgeons Act provides for the regulation of the qualifications and registration to practice locally for veterinary professional and paraprofessionals working in DVS and other veterinary facilities in the country.
- The Veterinary Surgeons (Veterinary Laboratories) accredits veterinary diagnostic laboratories including the vaccine production unit.

5 STRATEGIC FRAMEWORK

5.1 OVERALL GOAL

Zimbabwe animal health and food safety delivery systems transformed for increased productivity and market access increased

5.2 PURPOSE

Ruminant livestock morbidity and mortality due to tick-borne diseases reduced thereby contributing towards better animal health and increased income and livelihood support for communities.

5.3 OBJECTIVE

To sustainably control tick-borne diseases in ruminant livestock in the country as one of the key strategic interventions specified in the Zimbabwe Livestock Growth Plan.

5.4 STRATEGIC FOCUS

The document describes strategic interventions to be employed in the management of TBDs and their vectors to minimize the negative impact on ruminant livestock production in Zimbabwe. It recognizes the urgent need to reduce TBD cases and mortalities. Focus is not only on cattle but will also be on small ruminants, particularly the goats, which are equally important to some of these livestock producers. The strategy emphasizes the need for evidence-based decision-making based on localised solutions, with robust engagement of community and public and private players along the ruminant livestock value chain. It is also meant to be dynamic thus it can be modified as per changes in the situation. To achieve optimal results, the strategic interventions are best implemented as a unit as they complement one another. Under each strategic intervention, timelines for the achievement of the various intervention points have been set as follows:

- Short Term (1 year)
- Medium Term (2-3 years)
- Long Term (4-5 years)

Depending on the funds and logistical support available, it is therefore possible in the implementation to combine a few points from each of the strategic interventions.

The strategic interventions are aligned to the Zimbabwe Agricultural Policy Framework (2012 -2032), Zimbabwe Agricultural Growth Plan (ZAGP) and the Zimbabwe Livestock Growth Plan in the recognition that the majority of the population derives its livelihood from agriculture, of which the livestock sector is an integral part, hence the need to support the latter's transformation to a level where it contributes significantly to the national economy. The different broad areas on which the strategy is based are:

- Effective TBDs surveillance for early detection and reporting of cases,
- Sustainable, effective control of tick burdens on animals and the spread of specific species through chemical treatment integrated with other alternative methods
- Robust and sustained community participation,
- Effective Private-Public Partnerships (PPPs) in community-based livestock infrastructure development/maintenance and services, research and innovations,
- Creation of a supportive legislative and regulatory framework,
- Targeted complementary disease prevention through vaccination,
- Maintenance of a well-informed and competent animal health workforce in both the private and public sector,
- Generation of new knowledge on TBDs through sustained monitoring and research to support decision-making,
- Sustainable funding mechanisms involving all players along the ruminant livestock value chain.

5.5 STRATEGIC INTERVENTION 1: Prompt Diagnosis and Provision of Early Treatment

5.5.1 Current Status

Presently more than 90% of reported cases are diagnosed by DVS veterinary paraprofessional staff, mostly Veterinary Extension Workers (VEWs), based on case history, observed clinical signs and on a few instances post-mortem findings. Although TBDs are notifiable, reports of cases diagnosed by private veterinary practitioners and attended to by the farmers themselves are mostly rarely filter through to the DVS data capturing system and are not adequately accounted for in the official DVS case records. Accessibility of VEWs to farmers has however started to improve significantly following the allocation and deployment of over 1000 motor bikes to VEWs which has improved their mobility and the number of farmers they can attend to in a day.

Although laboratory confirmation of TBD cases using the microscopy method is fairly simple and can be done by district vets or trained vet paraprofessionals in a basic lab set up at a district or sub-district field office, less than 1% of all recorded cases have laboratory confirmation. This is caused by a number of reasons which include the following:

- Lack regular and structured in-service training to field officers to sharpen their sample collection, sample preparation and microscopy diagnostic skills
- Lack of sampling equipment, functional microscopes and sample preparation reagents at district and sub-district offices.
- Cost of sending samples to the provincial or central labs where the required equipment and expertise is.
- Where appropriate samples are taken and submitted to the provincial or central lab, the long results turnaround time makes the whole exercise not worthwhile for purposes of informing the appropriate therapeutic intervention by vet personnel on the ground.

As a result, the collection and submission of samples for TBD confirmatory diagnosis at the provincial or central labs is in most cases is currently only for purposes of data collection and analysis, which unfortunately is not the immediate interest of the affected farmer nor the vet personnel attending to cases on the ground. Their immediate interest is a timely and accurate diagnostic result that will help them make the correct, timely and cost-effective intervention to prevent further loses.

5.5.2 Short Term Strategic Intervention points

I. <u>Prompt disease recognition and reporting by farmers & livestock production personnel</u>

- The strategy recognizes the important role of farmers and other livestock production (e.g., Agritex extension) in the early detection of TBD cases their role in triggering the necessary response from DVS to prevent avoidable morbidities and fatalities.
- Extension services will be anchored on active involvement of livestock owners in the early detection of suspect TBD cases, reporting to DVS on time and the benefits of timely treatment of cases.
- The strategy will direct resources towards the creation of a critical mass of knowledgeable livestock farmers in every community to reduce the risk of dissemination of wrong information ahead of interventions from DVS.

II. Field clinical diagnosis done by Veterinary Extension Workers (VEWs)

- The ongoing clinical diagnosis by well trained and competent frontline officers will remain the cornerstone of TBD diagnosis in the field. This however will require continuous and sustained strengthening through the implementation of structured in-service training programs targeting mainly VEWs, the DVS frontline technical cadre at the farmer interface level. These in-service training programs will be designed at the beginning of each annual planning cycle and will be allocated a dedicated budget line to ensure at each serving VEW attends at least one refresher in-service training every two years.
- The in-service training program will inculcate the use of participatory epidemiology extension methodology to ensure active involvement of farmers in early disease detection and reporting.
- Newly recruited VEWs will work under the direct supervision of senior VEW or Animal Health Inspector (AHI) to ensure they acquire the critical competences to run their own station. Newly recruited VEWs will also be required to have received induction training before being deployed to their designated stations.

III. Access to curative medication for prompt treatment of sick animals

- The DVS will foster functional linkages with the private sector suppliers of veterinary medicines to ensure availability of affordable TBD curative drugs at the lowest DVS Farmer interface level in line with government policy of Government enabled private sector led economic growth.
- The DVS will explore potentially workable operational modalities for improved access to curative drugs that include, but not limited to the following:
    - Involving the veterinary extension worker as an intermediary between the veterinary drug supplier and the community they serve.

- Organizing dipping committees into community business consortia that will be allowed one of the rooms at AHMCs as a drug outlet that will be managed by the dipping committee consortium with mentorship from selected established vet drugs wholesaler or retailer
- Entering into PPP arrangements with private sector partners and establish a veterinary products retail outlets at AHMCs that will be run by the private sector partner on a profit-sharing arrangement.
- Renting out spare at the AHMC to private business to run a drug retail outlet.
- Direct import of essential curative TBD medication and distribution to AHMCs for purposes to resolving major TBD outbreaks

IV. Gradual increase of diagnostic microscopy at district level

- This strategy recognizes the important role of confirmatory laboratory diagnosis in the management of TBDs as it ensures appropriate and informed intervention measures are employed.
- Light microscopy, the simplest and most affordable diagnostic method, will adopted as the confirmatory diagnostic method.
- Some district offices do have the facility but has been redundant due to faulty equipment and other logistical problems, but the possibility to resuscitation is there

V. Back up confirmatory diagnosis at Provincial and Central Veterinary Laboratories

- The 3 provincial labs in Mutare, Bulawayo and Masvingo and the Central Vet Labs in Harare will continue offer TBD diagnostic services as has always been the case to farmers and field staff who find more convenient for early disease confirmation.
- In addition, the three provincial labs and CVL will serve as first line and second referral labs for the mini labs in district and sub-district offices where 5% and 1% of cases tested at the mini labs should be sent for second and third level confirmation
- All samples collected during structured active surveillance programs tested at the CVL.

5.5.3 Medium Term Strategic Intervention Points

IV. Sample collection and confirmatory diagnosis at district and sub-district level

- Availability of the microscopy diagnostic method will be decentralized from the Central and the three provincial offices currently offering this service to the rest of the provincial, district offices and selected strategically positioned sub-district offices.

- Procurement and distribution of microscopes and the necessary accessories for sample collection and preparation of slides to provincial, district and sub-district offices for the timely confirmatory diagnosis of TBDs will be prioritized.
- Standard operating procedures for the investigation and management TBD outbreaks should include the requirement to collect and submit samples for lab confirmation from at least 10% of all reported cases during the outbreak investigation phase and at least 1% of follow up cases during the outbreak management phase.
- Solar energy supply system will be installed at all district and sub district offices selected for the establishment of mini labs for TBD blood parasites microscopy.

VI. Sustained improved frontline staff mobility

- Long term sustainability feature for staff mobility will be developed to run alongside the ongoing ministry program that is procuring and providing motors cycles to extension staff.
- Sustainability feature to be explored will follow central government policy private sector led transformation that will allows active participation of private sector players

5.5.4 Long Term Strategic Intervention points

- Continue to reduce VEW / Livestock population ratio to improve access to veterinary services
- Continue to strengthen the district and subdistrict laboratories
- The CVL will be capacitated to conduct TBD blood parasite genotyping for purposes of minoring genotypes present in the country and detection of new genotypes which may be associated with atypical/severe outbreaks.
- Establish provincial diagnostic laboratories in the remaining 5 provinces that do not have functional provincial laboratories in order to improve the monitoring of district/subdistrict laboratories

5.5.5 Actions

- Develop and implement staff training programs that target to improve capacity of frontline staff to prompt and accurate clinical diagnosis
- Build capacity of farmers/other non-veterinary extension workers through participatory surveillance for early detection of TBD symptoms in animals and the importance of prompt treatment and reporting to DVS
- Build capacity for TBD light microscopic diagnosis at provincial/district/subdistrict level

- Install solar power at sub district offices to facilitate establishment of mini labs for decentralized confirmatory diagnosis of TBDs
- Crowd in private sector investment in the establishment of decentralized retail outlets for curative drugs for TBDs. and other diseases. The private sector player will be encouraged to actively participate in the training of dip tank committees and farmers in general on need for early disease and rapid and appropriate response to prevent avoidable loses.

5.5.6 Expected Outputs

- Prompt recognition of suspect TBD cases & early report to DVS and actively participate in the implementation of outbreak control measures
- Attendance of TBDs farmer reported cases by DVS frontline staff
- Timely management of outbreaks by the frontline staff with active community participation
- Reduced TBD related livestock mortality

5.6 STRATEGIC INTERVENTION 2: Effective Integrated Tick Control (Latif & Walker, 2016)

5.6.1 Current status

Like other vector borne diseases such as malaria and trypanosomosis, the chemical control of the tick vector has been the cornerstone of the fight against TBDs and will remain an integral part of their control. More so, ticks also have other direct effects which affect the productivity and welfare of the animals hence the need to moderate their levels on these hosts.

The aim of future control is to come up with sustainable tick control methods which integrate chemical control with other approaches so as to reduce the quantum of chemical applications in line with international best practice. This drive to reduce chemical applications in not only driven by the high cost of chemicals but is also meant to:

- Minimize the selection for resistance in the targeted tick species
- Curtail the persistence of the chemicals in the environment where they can adversely affect non-target flora and fauna
- Reduce the formation of chemical residues in animal products destined for human consumption.
- Over-application of chemicals also does not allow animals to carry some ticks which act as a constant natural booster of the host's immune system to tickborne pathogens. It maintains herds which are very susceptible, creating a state of enzootic instability to the TBDs. The situation that the country is in now, characterized by a high incidence of TBD outbreaks, reflects a sudden, overwhelming ticks and tickborne pathogen challenge in herds with low immunity due to years of intensive tick control.

It will be very difficult to safely reduce dipping in susceptible herds without rectifying the low herd immunity through for instance vaccinations which cover all the diseases which are a problem in the area in question. Modern acaricides also have some residual effect whereby they continue to be effective where they are required for several days post application e.g. amitraz total replacement dip (TAKTIC): 7 days (MSD Animal Health South Africa, 2020); deltamethrin dip (DECATIX): 7 days (Coopers, 2020); pour-on products even have longer residual effects.

Presently the country faces the challenge of the availability of dubious products on the market and incorrect use of the substances available. Historical evidence indicates that DVS involvement in tick control activities for the marginalized has certainly contributed to a high quality of products and their use, hence the slower development of acaricide resistance in Zimbabwe in comparison to other regional

countries. So far, the only documented acaricide resistance in Zimbabwe is for the 1-host tick, *R. B. decoloratus*, unlike in other regional countries where even the 2- and 3- host ticks are also affected.

5.6.2 Short Term Intervention Points

I. Adoption of tick control methods which prevent TBDs occurrence in herds with high TBDs outbreaks

- Tick control will remain intensive in herds with low herd immunity i.e., high morbidities & fatalities due to TBDs
- In commercial dairy herds, both large and small scale, where the breeds kept (e.g., Friesian, Jersey) are very susceptible to ticks and TBDs, tick control will remain intensive. Zero-grazing of such animals should be considered if funds permit. If at all the animals are to get grass supplements, forms such as hay or silage which pose the least risk to tick exposure should be used.
- The plunge dip is the most effective, most economical and most water-efficient way to apply acaricides on communal or individual herds with > 5 animals
- In A2 farming areas do not have plunge dips mechanized spray races or use of pour on applications will be recommended method for tick control
- Communities/cattle owners benefitting from the government run dipping program will be actively engaged, through their traditional leadership structures, in all tick control activities, from the mobilization of funds from individual cattle owners, maintenance of the dipping infrastructure and the actual dipping process with a view to instill community ownership of the whole process. Different stakeholders will have their roles well defined in the individual dipping committee constitution with responsibilities of key players outlined as follows:

Department of Veterinary Services (DVS)

- Superintend over the establishment of functional dipping committees for each dip tank covered by the communal dipping program
- Determine the appropriate dipping frequency dipping days for each communal dip tank in line with observed tick challenge and known life cycle of tick species in the different areas.
- Determine appropriate acaricides to be used in the country tick control program in liaison with the MCAZ
- Run dipping sessions, as guided by the Dipping SOP and maintain appropriate dipping records
- Manage livestock movements to prevent disease spread between epi units
- In consultation with MCAZ spearhead monitoring tick resistance to the acaricides in use and take appropriate action

- Coordinate procurement storage and distribution of acraricides for the communal dipping program in collaboration with respective LDCs

Livestock Development Committees/Dip tank committees

- Partner DVS staff on the ground as community representatives in all aspects of the dipping services delivery
- Mobilization of farmers to bring animals for dipping
- To act as the link between DVS and community leaders to ensure compliance of individual farmers to agreed responsibilities for effective delivery of dipping services in line with the LDC contitution

Farmers/cattle owners

- Bringing their cattle to the dipping site on the scheduled days in line with the cattle cleansing regulations
- Pay dipping fees in line with dictates of the cattle cleancing regulation
- Refill their respective dip tanks with freshwater where necessary in line with the dictates of the dipping SOP
- Participate in the maintenance and repair of the diptanks

Traditional leaders

- Facilitate active involvement of community members in the implementation of the communal dipping program
- Formulating and implementing instruments to ensure compliance of community member to agreed responsibilities in the implementation of a successful communal dipping program

Rural District Council

- Facilitate the development of by-laws reinforcing the compulsory dipping of cattle at the cattle owners' cost
- Support or facilitate the maintenance or establishment of dip tanks

II. Maintenance of enzootic stability in herds/areas with low TBD outbreaks are experienced

- DVS will continue to monitor chemical control of ticks using different types of registered acaricide and ensure maintenance an appropriate level of enzootic stability in the national herd by allowing appropriate exposure of animals to ticks.
- The main tick problems will therefore be due to direct effects such as weight loss/stagnation, damage to skin, damage to udder, lameness in small ruminants, etc.

- In this instance, tick control will be instituted when a certain proportion of the herd has a specified number of ticks which initiate skin and udder damage and other direct effects. Establishing such thresholds will require consistent close monitoring of animals by the owners and by the veterinary frontline staff.

III. Monitoring of the effectiveness of acaricides on a regular basis

- A guarded use of acaricides on a national basis is very crucial to prolong the effectiveness of the available chemicals, hence DVS will continue to play a major role in the national selection and acquisition of acaricides.
- Regular monitoring of acaricide concentration in dipping mixtures and effectiveness monitoring will be an on-going activity across the country to reinforce the quality control:
  - Random sampling of dipping mixtures to establish the active ingredient concentration prior to a dipping session
  - Acaricide resistance surveillance using not only the bioassays but also complemented by molecular methods:
    - National acaricide resistance surveillance every 5 years
    - Immediate testing of ticks from herds which exhibit signs suggestive of resistance

IV. Implementation of complementary non-chemical tick control methods

- Departmental staff, farmers and other extension workers will also be trained on the use of other means which can contribute to the reduction of ticks in the environment:
  - Alternating pastures and crops
  - Controlled animal movement with the policy of zero ticks on movement
  - Few wildlife hosts (if not a mixed farm)
  - Intact fences between farms, compartments and zones

V. Evaluation of the use of strategic tick control in TBDs susceptible herds (high disease incidence, high case fatality rates, low -medium herd immunity)

- The assessment of this strategic intervention point should begin as soon as possible. However, implementation of the results likely to come in the medium to long term.
- Because of the existence of a distinct wet and dry season in the country, strategic tick control of TBDs susceptible herds is worth a try. The main aim would be to impact the female ticks' reproduction

by interrupting their feeding which subsequently will reduce the number of viable eggs. If done properly, it should significantly reduce the numbers of ticks on the animals in the peak rainy season:

- Introduce intensive (weekly) acaricide treatment in the late spring, i. e. at the end of the dry season (September to October), to target the few adult ticks found during that period, before increase in their numbers.
- Continue intensive dipping for the next 3 months.
- During the period, assess tick loads on animals and their engorgement during the period and dip when necessary.

5.6.3 Medium Term Intervention Point

I. To come up with different tick control/management strategies suited for the various agroecological zones

- Establish different tick control strategies appropriate for different areas based on the enzootic status of herds, agroecological zone and TBDs enzootic statue in the herds
- Subsequently implement informed revisions to legislation such as the Cattle-Cleansing Regulations.

5.6.4 Long term Strategic Intervention Points

I. Promotion of the use of animal hybrids with resistance traits to ticks and TBDs

- Crossbreeding *Bos indicus* (e.g., Brahman) with *Bos taurus* (e.g., Hereford) to select for hybrids (e.g., Braford) with some tick resistance (from Brahman side) besides the excellent productivity traits (from Hereford side).
- The coordinated effort will involve breeding experts

5.6.5 Actions

- Rehabilitate/maintain dipping infrastructure inclusive of animal handling facilities
- Construct dipping facilities where there are non-existent
- Avail water of a suitable quality
- Monitor dip strength randomly prior to dipping
- Assess dipwash quality to determine if dip requires scooping
- Dip Attendant will be continue to be the person in charge of dipping and other related activities at the frontline
- Rear/maintain pathogen-free tick species colonies at CVL for acaricide testing assays
- Monitor development of acaricide resistance regularly
- Convince acaricide suppliers that resistance monitoring for their products is a public good

- Control ticks on other livestock (small ruminants, donkeys) besides cattle
- Use of the exact GPS position for each tick identified
- Train lower-level staff at district level on collection/preservation of live ticks for resistance testing

5.6.6 Expected Outputs

- Numbers of communities involved in organization of dipping activities increase
- Environmentally, socially and financially sustainable tick control innovations evident
- Breeds with TBDS resistance traits in the long-term

5.7 STRATEGIC INTERVENTION 3: Community Participation and Ownership

5.7.1 Current Status

This strategy is in line with one of the key success factors in the Zimbabwe Livestock Growth Plan, which reads: "Organization of farmers into strong commodity associations is a pre-requisite for the rapid achievement of the development strategies. Since smallholder farmers now own the majority of the country's livestock, they must become more organized and develop the ability to enter into the mainstream commercial economy". It allows the farmers to pool resources and negotiate prices for inputs such as in this case medicines & acaricides and for their products.

The small-holder group of farmers is currently not fully participatory in livestock management activities such as the control of ticks, TBDs and disease control activities in general. In a questionnaire survey conducted by OIE involving the veterinary services of member countries, most felt that resource constrained livestock keepers can play an important role in animal disease surveillance and control for as long as their integration is done in a manner which is appropriately regulated and supervised (Grace et al., 2008). Basic training of community members means easy access to basic animal health and management issues in areas without easy access to the veterinary services and drug suppliers ((Mugunieri et al., 2004). Questionnaire surveys done in Zimbabwe and South Africa also indicated the resource poor, traditional farmer's desire for more training on TBD recognition and effective control (Sungirai et al., 2016; Makuvadze et al., 2020; Yawa et al., 2020). A pastoral community in Kambala, Morogoro, Tanzania was able to establish a cooperative which positively addressed the financing of ticks and tickborne disease control (Mbassa et al., 2009).

Matabeleland South province and some districts in Matabeleland North, Masvingo and Mashonaland East were involved in a trial run of community based dipping program where farmers were organized through their respective LDCs to handle dipping processes in their own with minimal support from DVS. Up take of the program varied greatly from area to another

5.7.2 Short Term Strategic Intervention Points

I. <u>Improvement of farmer organizational skills in animal health activities</u>

- Prioritisation of the formation of farmers' groups/associations
- Ensure gender equity in community groups
- Involvement of organisations with some funding and experience in community mobilisation, such as the United Nations Development Program (UNDP) and non-governmental organisations (NGOs)

- Positive testimonials from communities where the participatory endeavour has been successful could be used as encouragement for others
- Change farmer behaviour towards TBDs control both voluntarily and by coercion (Jansen et al., 2012)
- End the treatment of communities as incapable

II. Farmer financial contribution towards sustainable treatment & control activities

- Mobilisation of finances from community members and other resources and relevant training in their management
- Regular review of financial contributions, based on the cost inflation index, to ensure stable funding.

III. Farmer/other non- veterinary extension worker training on basic skills for recognition and prompt communication to the VEW

- Training of the farmers on some basic aspects of TBDs recognition and management.
- Sensitize farmers/non-veterinary extension worker on the importance of prompt notification of the VEW about TBDs cases via SMS for prompt treatment and other remedial actions. Most communities have some access to at least one of the mobile networks. There should also be options to report cases of in in drop boxes located at district/subdistrict offices.
- Ensure gender equity

5.7.3 Medium Term Strategic Intervention Points

- Youth, i.e., the future livestock keepers, training where schools could be a focal point
- Re-enforcement of women participation will continue
- Broadcasting of TBDs recognition and management tips just before or at the beginning of the rainy season will be done
- On-going SMS reminders, organized with service providers, on pressing TBDs management issues during peak season
- Toll-free number and minimal details needed for reporting TBDs cases will be provided

5.7.4 Long Term Strategic Intervention Points

I. Sustained strengthening of community participation

- Although the DVS will always play a role in animal health activities, its role in community organization should eventually decrease
- Communities should play a major role in activities which safeguard the health of their animals

5.7.5 Actions

- Facilitate farmer organization
- Involve the non-veterinary extension workers
- Enable the mobilization of funds by communities
- Sustain gender balance in leadership and decision-making roles
- Farmer training with gender equity (inclusive of men, women, girls and boys) in basic disease recognition, sample collection and disease control
- Facilitate access to medicinal and other veterinary products/services

5.7.6 Outputs

- Educational material in local languages delivered on radio programs, SMS platform for important notifications
- Prompt reporting of suspected disease problems
- Prompt attendance to sick animals which will save animal lives
- Active participation of women and girls
- Early implementation of control measures
- Strong liaisons of community with the veterinary frontline staff
- Better financial returns for the livestock farmers

5.8 STRATEGIC INTERVENTION 4: Involvement of Private Sector

5.8.1 Current Status

DVS has experienced shrinking government financial resources over the years which has compromised the level of efficiency in service delivery. The situation has left the national herd very vulnerable to diseases and pests, in this instance TBDs and the vector ticks, previously well controlled. To overcome some of these challenges, the DVS will get into strategic formal partnerships, leveraging on the capital, managerial capacity, and know-how from the private sector. It also includes all players along the livestock value chain, such as livestock buyers/traders, slaughterhouses and others that process and market animal products. Private sector involvement is therefore urgently needed in the short to medium term, with possibilities of extensions. Effective Public Private Partnerships (PPPs) should increase the capability and capacity of the DVS to protect, maintain and improve the health and wellbeing of people through safeguard of the health and welfare of animals and provision of safe animal-derived food (World Organisation for Animal Health [OIE], 2019).

Examples of private sector are private veterinarians, livestock remedies suppliers (e.g., Veterinary Distributors, Coopers, Agricura, Pfizer), milk and milk by-products distributors (e.g. Dairiboard, Kefalos), Animal breeders, Livestock buyers, Abattoirs and Farmers' Associations particularly the commercial ones.

The broad roles which will be played by the private partners (Independent Evaluation Group [IEG] 2016):

- Service delivery only in a public owned facility
- Infrastructure/facility development: designing, constructing, and financing of a DVS/community facility
- Combination of service delivery and infrastructural development

Those sectors that might not necessarily have the expertise in terms of service delivery/infrastructure development could provide funding towards such activities (Refer to Strategic Intervention 11).

5.8.2 Short Term Strategic intervention points

The private sector involvement will help the country get out the TBDs crisis. Most of the activities at this stage will be at the community level, where the animals are.

I. Delivery of essential services

- Services such as tick control, supply of TBDs medication to communities, tick resistance testing, testing of chemical concentration prior to dipping, other animal husbandry issues
- Community members and frontline veterinary and paraveterinary professionals will participate

II. Repair of the essential infrastructure

- Refurbishment of facilities in communities such as water reservoirs, animal handling facilities, animal pens, diptanks, etc needed in the delivery of services mentioned

5.8.3 Medium to Long Term Strategic Intervention points

I. Design and construction of robust infrastructure

- Private sector will be contracted to develop some of the infrastructure which is needed where it currently does not exist or needs total refurbishment. This will likely take a number of years to achieve. Infrastructure will be at all levels:
  - Communities e.g. diptanks, animal handling facilities & water reservoirs
  - Subdistrict/District/Provincial e.g., laboratories, post-mortem facilities, backup power supply such as solar

II. Continue to provide services

At this stage there will be greater community participation

III. Private sector contribution towards research funding for sustainable national TBDs control

- Focus will be in areas of interest to the private players

5.8.4 Actions

- Construct/refurbish infrastructure
- Delivery of service/innovations in communities
- Transfer of skills to communities and veterinary DVS personnel
- Financial contributions towards national TBDs research

5.8.5 Outputs

- Transformed and sustained excellent service delivery and infrastructure in communities
- post the project life
- Ensure proper use of medicinal products including acaricides
- Regular update on resistance status of products in use
- Improved TBD control

5.9 STRATEGIC INTERVENTION 5: Surveillance (Cameron, 2012).

5.9.1 Current Status

The continuous, systematic collection, analysis and interpretation of health-related data helps to guide decision-making and action. It portrays the ongoing patterns of disease occurrence and potential so that investigation, control, and prevention measures can be applied efficiently and effectively. The DVS currently has a passive surveillance database system which comprises mostly disease records compiled monthly at district level, based on the farmers' observations and/or subsequent diagnosis by mostly its para-veterinary staff residing in the area at the owners' request. The data also includes the geographical locations (not necessarily GIS based) of these outbreaks and some epidemiological data around each case. However, it was accepted that the passive data might not have captured the entire TBDs cases, particularly those attended to solely by farmers, private practitioners and other players. It nevertheless does provide a fairly good representation of the overall trends. Active surveillance data is not shown if at all it is captured somewhere.

5.9.2 Short Term Strategic Intervention Points

I. Improved monitoring, planning and evaluation at high, medium and low levels of DVS, private and other sectors

- The system will be strengthened through the mapping of all important epidemiological units and creating a database of these at all levels, from headquarters (HQ) to AHMC, that forms the base of the department's information management system.
- There will be extension of animal disease data capture system to include cases detected at private veterinary practices and other facilities/players since all TBDs are notifiable and hence should be reported to the DVS.
- Data collection system should also accommodate TBD diagnosis and treatments made at farm level by lay persons and collected during routine farm inspections or structured returns from farm owners or enterprises. This will enhance the current data collection to ensure that it is reflective of the real TBD trends within the ruminant animal population.
- The epidemiology unit will generate TBD analytical reports published on a regular basis, say every quarter or half year.

II. Enhanced active surveillance

- Active surveillance is necessary to address specific questions such as level of exposure to infection, estimation of immune responses, changes of infection over time and differences of infection levels

between regions. It will provide the department with the accurate information necessary for the modifications and adaptations of TBDs management approaches.

- Most of it normally will come in the form of structured surveys which must be planned to achieve precision, require a clear definition of the target population to which the results can be generalized, are difficult to organize and are expensive.
- Such population-based surveys must be done regularly, often every 5 years, but will be increased if the need be.
- Designing and operationalization of the active surveillance program for ticks &TBDs is the responsibility of DVTS diagnostics and research branch and should be included in departmental annual workplans. Budgetary provision through the fiscus and other funding sources will be made for active surveillance data collection to enhance the country's ticks &TBD early warning system.
- Results of these survey should be within the shortest time possible to warrant their relevance.
- Some countrywide surveys needed in the short-term:
    - Determination of the immune status (antibody levels) of the herds to TBDs (Explore use of blood spots of filter paper[2])
    - Livestock tick survey: to determine the current temporal and spatial tick distribution

III. Create intersectoral collaboration

TBDs control and management can be strengthened through collaboration with other departments in the agricultural ministry, other government departments, local authorities, tertiary institutions, private sector and NGOs.

- Formation of an intersectoral partnerships
- Signing of Memoranda of Understandings (MOUs) on agreed roles and responsibilities
- Guidelines for involvement of NGOs, etc

5.9.3 Medium Term Intervention Points

Molecular characterisation of *Theileria* species in animal blood and in the vector ticks[3] with particular attention being given to outbreaks, and for comparison samples will be analysed

[2] Use of dried blood spots on filter paper. It is worth exploring their use for serological assays. They are commonly used for genotyping but others have also used them for serology. They offer several advantages over serum when resource and environmental conditions are challenging. Dried blood spot collection is less expensive, less time-consuming, relies on more portable equipment, and can be done effectively by a minimally trained individual (Santos et al., 2018; Su et al., 2018). However collection of the samples and handling of the filter papers should be done with care to minimise contamination

[3] Blood fed tick specimens picked off hosts are useless for studying pathogens transmitted by these ticks because results obtained after analysing crushed whole specimens are as good as testing a blood sample from the animal. The ticks to target for this purpose are:

- Unfed ticks collected from the environment (vegetation, pens) as they wait for a host to attach onto

concurrently with the vaccine strain *T. parva* Boleni and other regional and local *Theileria* strains. This should allow the DVS to decide on possibility of a wider role out of the vaccine against January disease.

- Molecular identification of tick vectors, particularly the differentiation of *Rhipicephalus Boophilus* species, to keep track of the *R. B. microplus.*
- Implementation of intersectoral collaboration
    - Identification of training needs of other sectors personnel and subsequent training
    - Execution
    - Establishment of a reporting mechanism by other sectors to DVS

5.9.4 Long Term Intervention Points

- Work towards the provision of an electronic platform where veterinary professionals for all sectors can input TBD data
- Wider tickborne pathogen genotyping will be done on a continual basis and could be increased if need be. The parasite genotypes will then be linked to phenotypic characteristics such as transmissibility, level of parasites in blood and other tissue, severity of disease caused, etc.
- Strengthening the local capability for molecular identification of tick species and identification of acaricide resistance traits.
- Increased intersectoral initiatives
- Monitoring and Evaluation system for intersectoral collaboration

5.9.5 Actions

- Investigate all passive TBD outbreak reports, including rumours, record, and report findings from all sectors
- Select and assess suitability (sensitivity and specificity) of serological assays for local use
- Acquire primers and other reagents for molecular analysis
- Acquisition of reagents
- Ensure the required facilities/equipment are in place
- Ensure availability of adequately trained personnel

- From sentinels, i.e. animals without acaricide treatments, run in the targeted area for a 24-hour period after which attached ticks (pre-engorgement) are picked off these hosts
- If the only available specimens are fed ticks from animals, one would have to dissect out the salivary glands (pathogens transmitted end up in these glands) but if ticks have fully engorged, most parasites if not all will have been inoculated into host hence chances of picking them up are low

- Train lower levels of employees at district and community level in tick sample collection and preservation
- Recording the exact GPS position for each sample
- Adequate data compilation facilities: computers, if possible, internet
- Design sampling strategies for the different surveys
- Organise logistics for sample collection:
- More regular collection, collation, analysis and sharing of data

5.9.6 Outputs

- Percentage of reporting units submitting reports in prescribed time increases
- Regular reports on TBDs cases received from private sector
- Outbreak investigation evident in form of molecular profiles of pathogens & ticks
- Timely dissemination of feedbacks to districts and communities.
- Prompt dissemination of processed surveillance information for it to impact decisions which improve management, prevent outbreaks though increased awareness, etc
- Indications of movement patterns of tick vectors and the pathogens they transmit
- Immune status of herds to TBDs established
- Number of successful intersectoral formal and informal partnerships in place

5.10 STRATEGIC INTERVENTION 6: Legislation/Regulatory Framework Reviews

5.10.1 Current Status

The legislation which sets out the policy on T & TBDs control and the regulations used to implement that policy require reviews which are in line with this strategy. Some of these reviews will come much earlier than others, depending on the need and practicality. Enforcement of these legislations is also very weak.

Animal movement control (including quarantine and fencing) for instance is very crucial in restricting the spread of ticks as the latter can only be moved significantly when they are on animals, hence the necessity for immediate reviews.

- The movement of small ruminants in this country was to a large extent unrestricted, hence they most likely contributed to the spread of ticks.
- Intact fences also keep most animals within the confines but presently most of such barriers no longer exist.
- Cattle being moved even to slaughterhouses are supposed to be tick-free, but for some time compliance has been very low. *Amblyomma* ticks have spread to cover almost the entire country, spreading heartwater to a very susceptible domestic ruminant population. There are indications as well that *R. B. microplus*, the vector for the more virulent *Babesia bovis*, is spreading inland from areas at the periphery of the country where the tick is prevalent. The cattle herds in these newly invaded areas are very vulnerable due to the lack of a previous exposure.

Identification and traceability of the origin of livestock is currently very poor and it compromises the ability to trace the origins of infectious diseases including TBDs.

The department has already initiated reviews of some parts of the Animal Health Act and the Veterinary Surgeons Act which will facilitate the implementation of this strategy.

5.10.2 Short Term Intervention Point

I. Regulation of movement of more domestic animal species other than cattle and pigs

- Inclusion of sheep and goats on the list of specified animal species
- Introduction of movement permits for sheep and goats

II. Mandatory inspection of animals prior to movement by an authorized person at the point of origin

- Authorised person will ensure animals are compliant

- Non-compliant will not be moved
- Appropriate corrective measures will be instituted prior to another inspection
- Training of more inspectors will be needed
- Declaration by owner that animals to be moved are tick-free

III. Development of a robust national livestock identification system

- Livestock identification and traceability systems are increasingly being used worldwide to support animal production, trade, and public health interventions but remain poorly developed in Zimbabwe and most African countries (Mutua et al., 2018). Such a system would certainly be of assistance in tracing the origins of the uncommon ticks, TBDs and genotypes of tickborne pathogens associated with unusual outbreaks.

IV. Replacement of zonal and compartment fences

- Replacement of FMD zonal fences will be of assistance
- Communities that wish to create these export compartments will most likely need to have some form of boundaries which separate their animals from the rest. Such boundaries will also assist in control of the movement of the tick vectors.

5.10.3 Medium- Long Term Intervention Points

I. Creation of farm boundary fences

- As part of community engagement, farmers will be trained on the advantages of erecting perimeter fences around their properties. This might be difficult in communal land setups where grazing is shared but should be possible for the small holder farmers
- There should be hefty penalties for those who vandalise these fences

5.10.4 Actions

- Review of animal species on the specified animal list
- Increase vigilance for non-compliance
- Increase prosecutions for non-compliance
- Improve animal traceability

5.10.5 Outputs

- Reviewed regulations promptly approved and published
- Better individual animal identification and traceability
- Less cases of non-compliance

5.11 STRATEGIC INTERVENTION 7: Vaccination/ Immunisation

5.11.1 Current Status

TBD vaccination will be used as an integral component of the country's integrated TBD control strategy. The vaccines have been produced locally at the Central Veterinary Laboratory (CVL) since the mid-1990s and are listed in Table 7. They underwent wide-scale field efficacy and safety trials which are documented in peer-reviewed international journals. The department, however, does not produce a heartwater vaccine such that areas where the disease is endemic will have to rely on dipping to keep heartwater under control. The heartwater vaccine used by some of the local farmers is purchased from OVI, South Africa. The vaccination is currently being rolled out on a selective basis in consultation with DVS.

Table 7: Cattle TBD vaccines produced at CVL and doses currently available

	Vaccine strain (Origin)	Characteristics	Doses available
Babesia bigemina	*B. bigemina* G-strain (Queenland, Australia)	- Not tick-transmissible - Offers excellent cross-protection against local *B. bigemina* strains	35,000
Anaplasma marginale	*A.centrale* (South Africa)	- Confers good cross-protection against most *A. marginale* strains	35,000
Cattle-derived *Theileria parva*	*Theileria parva* Boleni (Goromonzi, Zimbabwe)	- Offers excellent cross-protection against local cattle-derived *T. parva* strains - No cross-protection against buffalo-derived *T. parva* strains	13,500 but still have to undergo efficacy and safety testing

The vaccines are the live types which require a cold chain and special handling to ensure their viability prior to inoculation into the animal. Additionally, monitoring the vaccinated animals is also crucial. Hence, the vaccinations are done under the supervision of veterinarians. The *Babesia/Anaplasma* vaccines are the blood type whilst *T. parva* Boleni[4], for the prevention of January disease, is a ground-up tick-stabilate. The *Babesia*/*Anaplasma* vaccines can be administered in combination if a property/area has problems of both babesiosis and anaplasmosis. In Zimbabwe, the vaccine against January disease is administered without oxytetracycline therapy (unlike in the rest of the region) which reduces the vaccination costs significantly.

[4] *Theileria parva* Boleni cannot be used to immunise against Corridor disease

Vaccines are meant to raise the herd immunity to a protective level expeditiously and uniformly on properties with verified generalized low to medium antibody levels and/or high disease incidence which may also include high fatality rates. An animal only gets a single vaccine shot during its lifetime, immunity develops in a few weeks (4- 6 weeks depending on the pathogen) and protection is lifelong for as long as a few ticks which act as a regular, natural immunity booster are maintained on the animal. Post vaccination, tick control will be appropriately reduced to allow constant exposure to a minimal number of ticks which act as an immunity booster. However, this might be difficult if other TBDs such as heartwater are not covered.

Vaccinations are best done before the rainy season, to ensure animal protection before the peak tick season when TBDs transmission is at its maximum. In the first year, all animals on the targeted property or area will be immunized then in subsequent years animals introduced and born after the last vaccinations are done.

5.11.2 Short Term Strategic Intervention Points

I. Production of sufficient efficacious and safe vaccines

- Local production of vaccines will continue in line with the Livestock Growth Plan
- CVL capacity to produce adequate vaccines of the expected quality will be assured though enhanced development of infrastructure, inputs supply and personnel
- Documentation of the Standard Operating Procedures (SOPs) will be done
- Vaccines and facilities will be registered with the relevant regulatory bodies

II. Storage & distribution of vaccines

- Currently CVL has acceptable cold-chain facilities
- Purchase of more narrow-necked portable liquid nitrogen tanks for the immunization campaigns will be done

III. Train adequate personnel

Both the production of these vaccines and their distribution to the end-user is more complex that that of the other common animal disease vaccines. It therefore important to carry oout training of the following:

- veterinarians, scientists, technical and other non-technical staff in relevant aspects of vaccine production and laboratory animal upkeep
- Field veterinarians in the handling and administration of the vaccines

- Veterinarians, VEWs, Dip Attendant, farmers, etc. in monitoring of herds post-vaccination

III. Immunization of animals

- Immunisation will be carried out selectively on farms/in areas with problems, in consultation with DVS. Vaccination is recommended on properties which are well organized and properly fenced under the supervision of a veterinarians. Farmers with highly productive taurine breeds (dairy farmers, stud breeders) will benefit from the immunization.

5.11.3 Medium Term Strategic Intervention Points

I. Establishment of better facilities for long-term storage and distribution of vaccines and seed stocks

- A bulk liquid nitrogen facility shared with Animal Breeding facility will be established at the field station in Mazowe
- Identification of another facility to serve as backup for storage of the seed stocks will be done

II. Training of senior technical and veterinary staff at established regional TBD vaccine facility

- Personnel will be sent to facilities such as Ondesterpoort Veterinary Institute (OVI) in South Africa (*Anaplasma* and *Babesia* vaccines) and the Ticks and Tickborne Centre in Malawi (mostly for the *Theileria parva* vaccine).
- The centres also have experiences in TBDs diagnostics and vaccine delivery to the farms.

5.11.4 Long Term Strategic Intervention Points

I. Consideration of wider role out of vaccines

- The DVS will look closely at how best the vaccines could be used in TBD hotspots in A1, A2 and communal land areas where 90% of the vulnerable herd is. Active surveillance of parasite genotypes will certainly be needed to support such a move.

II. Opportunies PPPs in vaccine production

- Production of these live vaccines is very costly. However, the world over the production of these fairly crude vaccines has not been entirely taken over by private companies. The possibility of PPPs in vaccine production will be explored, whereby roles & responsibilities of each party are clearly set out right at the beginning.
- Even though the production of vaccines against the less common *Babesia bovis* and buffalo-derived *T. parva* is currently not being done, the capability to produce them if need be is there.

5.11.5 Actions

- Prompt efficacy & safety testing for the available *T. parva* Boleni vaccine

- Advanced estimates of the doses required for each vaccine type before the next vaccination period
- Market the vaccines
- Ensure adequacy of the production facilities and inputs (Detail to be addressed separately):
- Train farmers on post-vaccination monitoring of animals
- Avail (or produce) heartwater vaccine[5]

5.11.6 Outputs

- Sufficient stocks of ready-to-use vaccines
- A good proportion of herds vaccinated
- Evidence of reduction in TBDs occurrence

[5] The available vaccine (also a live vaccine) is produced by OVI, South Africa. It is used to vaccinate all the domestic ruminants: cattle, goats and sheep

5.12 STRATEGIC INTERVENTION 8: Human Resource and Capacity Building

5.12.1 Current Status

Adequately trained personnel at all levels in the right numbers are essential for effective implementation. The turnover of the higher level of staff: veterinarians employed in the field, in laboratories and at head office in data management and technicians is currently high. Replacements are often inexperienced. Many of the experienced lower-level staff are also reaching retirement age. Hiring freezes at all levels have also been quite common due to budgetary constraints. Some of the professionals required are the following:

- Head office/CVL: Epidemiologists, Software technicians, Data managers, Acarologists/Entomologists, Protozoologists, Technologists/Scientists specialized in Parasitology and/or Molecular biology, Technical assistants (in-house trained)
- District level: Data managers, Technologists/Scientists, Technical assistants, Veterinary extension staff

5.12.2 Short Term intervention points

I. Filling up of vacant positions with relevance to ticks and TBDs aspects

- The aim will be to create the necessary critical staff mass which is needed at all levels
- Individuals with basic qualifications but without the necessary experience will be considered as they can be trained in-house by a senior experienced persons and be sent for short-term training attachments at regional facility with the necessary expertise.

II. Provision of in-house training and outside (national, regional and international) career development opportunities for personnel

- This will be necessary to ensure that the inexperienced personnel engaged, which is currently the norm in most public institutions get the necessary training.
- In-house training will be an ongoing activity at all levels
- The regional centres such as the Centre for Ticks and Tickborne Disease in Malawi, which specializes in ticks and & TBDs, are excellent places where senior scientists including technical staff could gain invaluable experience in vaccine production, diagnostics and control.
- Regular refresher courses are necessary to update knowledge and create a pool of future expertise which can move the country forward in TBDs management. These will involve individuals from the private sector, tertiary and other institutions with the relevant experience

5.12.3 Medium Term Strategic Intervention Points

I. Postgraduate training to Master and Doctorate levels for first degree holders

- Candidates with first degrees will be encouraged to enroll at tertiary institutions for postgraduate studies for their personal development.
- Studies done will be designed to address compelling questions with regards the TBDs agenda.

5.12.4 Long Term Strategic Intervention point

II. Nurturing of managers and leaders

- This is necessary for an effective succession plan in the management of TBDs

5.12.5 Actions

- Recruit appropriate people
- Induction training at beginning of job
- Relevant training support (including management where necessary) during career
- Participate in Continuous Professional Development (CPD) organised by professional associations
- Organise annual workshops on TBDs
- Organise annual conferences on TBDs research

5.12.6 Outputs

- Most of staff positions at all levels filled
- A number of training courses conducted in the year
- A number of staff with evidence of on-job (including management) training:
    - Certificates of attendance
    - Postgraduate degrees
    - CPD attendance
    - Ability to fulfill the set objectives on time
    - Up-to date information on TBDs available

5.13 STRATEGIC INTERVENTION 9: Establishment and Maintenance of Infrastructure & Equipment

5.13.1 Current Status

Infrastructure and equipment covered here pertains mostly to CVL needs in terms of support to ticks and TBDs diagnostics, surveillance research and vaccine production but also touches on requirements at community and district levels.

- CVL: A detailed appraisal (challenges observed and proposed solutions) of the CVL facilities was submitted to the Director DVTS.The facilities in general have suffered major deterioration over the years. There are several pieces of obsolete equipment which are occupying much-needed space in several parts of the building. Basic cleaning of the facilities inclusive of the animal pens in some areas was lacking and the immediate surroundings of the animal pens were covered with overgrown grass and shrubs which could be a source of ticks for the experimental animals. The borehole water did not feed into the municipal water supply system to the animal facilities, hence in these times when municipal water is hardly available, the facilities do not have running water most of the time.
- Subsidiary Provincial//District/Subdistrict laboratories level: The locations of provincial and district laboratories has already been mentioned under Strategic Intervention 1. The infrastructure has deteriorated, to a large extent the equipment needs replacement and power supply from national grid is unreliable and more laboratories needed.
- Community level: According to the Auditor-General, of the 3762 diptanks, approximately 71% needed some repair work (Anonymous, 2018). Work on the refurbishment of diptanks is already underway. Most A2 farming areas lack dipping facilities. Constant quality water supply is also a challenge in some areas particularly in the dry ones.

5.13.2 Short Term Strategic Intervention Points

The focus in the first year will be on strengthening the facilities at community level and at Central Veterinary Laboratory (CVL)

I. <u>Infrastructure development</u>

- A phased upgrade of the deteriorating laboratory infrastructure will be done, and regular maintenance of the infrastructure is necessary, and equipment is necessary to slow down the deterioration at CVL.
- Basic cleaning of facilities and clearing of surroundings is essential to assure the public of a high quality of services and vaccines.
- Relevant training ranging from basic to specialized for cleaning/animal caring for all levels of personnel working in laboratories and animal facilities, with emphasis on the welfare of research animals, is an obligation.

- Completion of the refurbishment of the experimental cattle facilities at CVL will be completed
- Refurbishment of the exsiting dipping infrastructure (diptanks, animal handling and holding facilities, water supplies)

II. Equipment repair/replacement

- An audit will be carried out to identify obsolete equipment pieces which should be disposed off Removal of such equipment will also provide more working spacing.
- Some of the equipment will need repair work and servicing. Microscopes for instance are very essential part of this strategy, but most of them have not been serviced for a while and some lack small items such as bulbs.

III. Other essential support services needed

- Reliable internet connectivity should also be always available for the execution of some of the work and to ensure prompt communication with collaborators and clients
- The procurement process should be improved in terms of the time taken to procure and screening of the trustworthiness of suppliers
- Adequate transport will be made available for the essential follow-up activities by laboratory personnel
- Twinning with regional and internationals centres/laboratories with the relevant capability will be done. Employees of the DVS will have the opportunity to spend time at some of these places e.g. CTTBD in Lilongwe, OVI in Pretoria South Africa,

5.13.3 Medium Term Intervention Points

I. Bolstering of the existing community and central facilities will continue

II. Work will also begin on:

- Construction of essential facilities at community level
- Improvement of the existing provincial laboratories at Bulawayo, Mutare and Masvingo and district laboratories. The aim will be to decentralizing the ability to offer the confirmatory laboratory diagnosis and the ticks and TBDs surveillance.

5.13.4 Long-term Intervention Points

- Continue to improve on the existing facilities, equipment and other needs
- Construction of provincial laboratories in remaining provinces and at subdistrict level

5.13.5 Actions

- Refurbish/Construct:

- ✓ Community facilities e.g diptanks, reliable water supplies like boreholes
- ✓ District level: basic laboratory space
- ✓ CVL[6]: Tick section, Protozoology laboratory, Molecular laboratory, Animal facilities, Tick-breeding facilities, Vaccine storage facility

- Replace/purchase equipment:
  - ✓ District level: microscopes, computers, standby generator, fridge/freezer
  - ✓ CVL[7]: microscopes, liquid nitrogen tanks, liquid nitrogen, laboratory (inclusive of tick section) equipment, etc.
- Maintenance of biosecurity in and around CVL experimental animal pens
- Improve management of experimental animals
- Ensure provision of commercial feed for experimental animals
- Provide appropriate vehicles dedicated to support TBD related activities
- Comply with good laboratory practices
- Twinning with laboratories in developed world and region engaged in similar work
- Improve procurement process

5.13.6 Expected Outputs

- Improved facilities that comply with international animal welfare standards
- Increased service delivery through use of functional and state of the art equipment
- Accurate and timely laboratory diagnosis for informed decision making
- Relevant and accurate problem-solving research results from the use of experimental animals that are well management inclusive of welfare
- Improved mobility of veterinary service providers for early detection and rapid effective response
- Increased market confidence for locally produced animals and animal products that adhere to international standard protocols

[6, 7] A document which appraised the CVL infrastructure, equipment and other needs was submitted to the Director of Veterinary Technical Services

5.14 STRATEGIC INTERVENTION 10: Research

5.14.1 Current Status

Most of the TBDs research being carried out in the country for quite some time has not been driven by the national needs. However, of late there have been some nationally driven projects. An example is the Livestock Production Systems in Zimbabwe (LIPS-Zim) project which is European Union (EU) funded and aims to address ticks and TBDs in the small-scale areas in Zimbabwe's semi-arid agro-ecological regions IV and V. It involves for partners: The French Agricultural Centre for International Development (CIRAD), International Livestock Research Institute (ILRI), The International Maize and Wheat Improvement Center (CIMMYT) and the University of Zimbabwe (UZ).

5.15 Short Term Strategic Intervention Point

I. Formation of a national body which oversees TBDs management

- The body will comprise researchers from DVS, Universities, private and other sectors
- One of its mandates will be to hold TBDs conferences where local and other research findings of interest are shared

5.15.1 Medium Term Strategic Intervention Points

I. Development of the national capacity for problem-solving research

- Studies which provide information that allows the implementation of some strategic interventions should be prioritised. Examples:
    - Community based participatory interdisciplinary research which enables communities to participate in activities and decision-making
    - Tick surveys for specified regions
    - Molecular characterization of *Theileria* in both the host and the vectors

5.15.2 Long-term Strategic Intervention Point

Development of the national capacity for cutting edge research

- Cutting edge research incorporates the new technologies, is multidisciplinary and involves both researchers and clinicians in the invention of better methods of diagnosis, treatment and prevention of TBDs through the better understanding of disease process.
- Eventually such research is likely to produce better TBDs vaccines that are much easier and safer to use
- Investment into adequate facilities, equipment and personnel should be a top priority

5.15.3 Actions

- Formation of a national T & TBDs research steering committee which sets out research and other priorities
- Send out calls for need-driven project proposals at least one annually
- Avail some funding for the projects from national budget
- Involve PPPs
- Explore other funding sources including external
- Prompt dissemination of results
- Creation of an institutional repository for DVS
- Safeguard intellectual property rights in research agreements with external partners
- Explore together with the veterinary profession the revival of the Zimbabwe Veterinary Journal

5.15.4 Outputs

- Employees in TBD in DVS co-author research
- Problem-solving research innovations
- TBDs research results better disseminated
- Evidence-based policy decisions

5.16 STRATEGIC INTERVENTION 11: Adequate Financial Support

5.16.1 Current Status

Without adequate finances, it will not be possible to implement the strategy or even parts of it. The lack of adequate finances is one of the major reasons for the current failure to control diseases including TBDs. Currently, most of the finances used in TBDs control are provided for through funds allocated to the DVS by central government and levies such as the dipping levy collected by DVS. Over the years the funding has not been sufficient due to a sharp decline in the value of the local currency.

5.16.2 Short-term Strategic Intervention Points

Mobilisation of sufficient funds to get out of the current crisis where TBDs morbidities and fatalities are very high.

- Provision of adequate government funding to import the various medication, chemicals infrastructure inputs, etc. required in TBD control
- Farmer contributions (fees/levies) which are reviewed regularly based on inflation index to ensure stable funding. Effective checks and balances should be in place to ensure that the funds are not corruptly diverted for unauthorised uses to ensure sustainability. Such community contributions nowadays are likely to attract external donors.
- Public-Private sector Partnerships (PPPs) where the various players along the livestock value chain contribute. Highly productive livestock farming with minimal disease is essential for thriving business along the livestock value chain.
- Operational non-governmental organisations (NGOs) which seek to achieve small-scale change within the communities through projects

5.16.3 Medium to Long-Term Intervention Points

Guarantee adequate funding to for sustained TBDs control

- Sustenance of local funding into the medium to long term: government funding, community contributions and PPPs
- Complimentary external funding (Nowadays most funders are attracted if the beneficiaries are also contributing something) from e.g.:
    - OIE, IAEA, FAO (funding for professional and farmer training)
    - World Bank/AfDB (loans)
    - Renewal or new NGOs

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