Journal of Veterinary Research Advances
ISSN: 2582-774X

Review Article
Open access

Effects of ectoparasites on cattle in agro-ecological zones in Nigeria- A review

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Received on: 30/05/2024 Accepted on: 05/10/2024 Published on: 11/10/2024

ABSTRACT

Ticks infesting cattle in Nigeria were reported in different magnitude ranges, from 28.5% to 100%. The three genera of ticks reported to occur on cattle in Nigeria are *Dermacentor, Haemaphysalis* and *Ixodid*. Among these three genera of ticks infesting cattle in Nigeria, *Dermacentor* was the most predominant genus, followed by *Ixodid*. *and Haemaphysalis*. The main tick species reported to infest cattle in Nigeria are *Dermacentor variabilis, Dermacentor andersoni, Ixodes scapularis, Ixodes pacificus, Amblyomma maculatum* and *Amblyomma americanum,* in order of predominance. The overall prevalence of mange mite infestation ranges from 10.7% to 94.1% in cattle from Nigeria. The main species of mite reported in Nigeria is *Dermatophagoides pteronyssinus*. The overall prevalence of *Demodex folliculorum* infestation in cattle in Nigeria ranges from 23.9% to 82.6%, whereas the overall prevalence of lice was 6.1%. The most abundant genus of biting flies reported was *Austrosimulium,* followed by *Ceratopogonidae*, from Nigeria. *Trypanosome evansi* is a protozoan parasite that affects cattle in different parts of Nigeria outside of the tsetse fly belt areas. Only a preliminary report on *Theileria mutans* in cattle was reported in Nigeria. It concluded that ectoparasite infestation causes a serious economic loss in cattle production and productivity, which warrants the institution of appropriate control strategies to improve the health and productivity of cattle.

Keywords: *Dermacentor, Haemaphysalis, Ixodid,Dermatophagoides, Demodex, Austrosimulium,* Ectoparasites, Ticks.

Cite This Article as: Ahaotu EO, Simeon-Ahaotu VC, Alsharifi SKA, Herasymenko NV, Hagos HA and Iheanacho RA (2024). Effects of ectoparasites on cattle in agro-ecological zones in Nigeria- A review. J. Vet. Res. Adv., 06(02): 76-87.

Introduction

Nigeria is one of the countries with largest cattle populations in Africa. The ability of cattle to withstand torrid heat and extreme desiccation is of paramount importance in determining their distribution. The cattle is primarily kept for milk production, meat production, draft power, transportation, best of burden, and as an agricultural draft animal (Hourrigan, 1979). The cattle is also a financial reserve and plays an important role in social prestige and wealth. However, despite its significant contribution to the livelihood of pastoralist society, there is very little scientific information about the health and productivity of the cattle (Islam *et al.,* 2009).

The slow reproduction cycle, high calf mortality, and other health problems are major constraints that contribute to the decreasing cattle herd population and productivity. Ticks, mange mites, and insects are among the most important health problems for cattle in Nigeria (Werede and Afera (2014). Ectoparasites are very common and widely distributed in all agro-ecological zones in Nigeria (Kumsa *et al.,* 2012). The ectoparasites of cattle and their diseases transmission are important constraints to the production, productivity and performance of animals (Regassa *et al.,* 2015). Ticks are one of most important factors affecting the health of cattle and transmit various diseases by causing pathogens, causing blood loss (Eke *et al.,* 2021) and causing damage to the hides and udder. The feeding activity of ticks is associated with several health problems in livestock, including cattle (Wall and Shearer, 1997).

In Nigeria, ticks are common in all agro-ecological zones of the country (Kumsa *et al,* 2012).The most important tick species reported to infest cattle in different parts of Nigeria include *Dermacento rvariabilis, Dermacentor andersoni, Ixodes scapularis, Ixodes pacificus, Amblyomma maculatum* and *Amblyomma americanum* (Sofizadeh *et al*., 2014, Dinka *et al*., 2010, and Kiros *et al*., 2014). *Dermacentor* and *Haemaphysalis* are of very low proportions (Hussen, 2018, Soulsby, 1982 and Kamal *et al*., 1996). Cattlel mange is an extremely contagious ectoparasite caused by the parasitic mite, *Dermatophyagoides pteronyssius,* which is transmitted by direct or indirect contact. Cattle mange is often considered the most parasitic disease, second to trypanosomiasis 'surra', in affecting cattle production and productivity (Wall *et al*., 2011). *Demodex folliculorum*is also another ectoparasite affecting cattle in Nigeria (Stuti *et al*., 2007, Kissi and Assen, 2017, Mumed and Gemeda, 2015 and Regassa *et al*., 2015). *Demodex folliculorum* causes nasopharyngeal myiasis in cattle and results in health hazards and severe economic losses in the cattle industry (Hanem *et al*., 2013).

Ectoparasites are very important economically on a global scale, and they are responsible for a great variety of livestock health problems. In addition to transmitting diseases, ectoparasites reduce milk and meat production and increase susceptibility to other diseases (Mekonnen *et al*., 2007). Despite the presence of a high population of cattle and their great social and economic importance to their owners, there is scanty information.

Therefore, the present review is designed to compile the available information on ectoparasites and their impacts on cattle in Nigeria with the objectives to compile high quality information on the presence, identity and status of ectoparasites, their effect and associated pathogens of cattle existing in different parts of Nigeria based on the available previous information.

Ectoparasites are organisms that live on the surface of bigger animals upon which they depend for food, shelter and other basic needs to survive (Rechav and Nutall, 2000). It has been observed that ectoparasites do not only have direct effects on their host, they may also transmit pathogens, thereby acting as vectors of diseases (Parola *et al*., 2001). Ectoparasites generally affect the health of animals and the quality of hides and skin. The leather industries have suffered great loses over the years because of infestation of animal skin.

Ectoparasites are a serious threat to both animals and humans all over the world. The painful bites of ectoparasites could be a great nuisance, leading to loss of a large amount of blood (Alasaad *et al*., 2008). For instance, ticks alone transmit several important protozoans, rickettsia, bacterial and viral diseases to animals, thereby causing great economic losses. Lice and mites usually cause dermatitis which is characterized by alopecia and necrotic foci. There is also intense pruritus (especially with mange), which leads to biting and vigorous scratching of affected parts (Shiferaw, 2018).

Mange is highly contagious skin disease caused by one or combination of several species of mites. These include species from genera *Sarcoptus, Chorioptus, Psoroptus* and *Demodex*. Some species are more globally distributed (Jarso *et al*., 2018).The common species of mites which affect cattle are *sarcoptic* and *psoroptic* mites (Mouchira, 2009). *Sarcoptic* mange in cattle caused by *Sarcoptes scabiei* is considered to be the most serious zoonotic mange (Singh and Momin, 2001). *Sarcoptes scabiei* is one of the most commonly encountered cattle diseases in Northern Nigeria with severe clinical manifestations. Infestation of skin caused by mites is a serious problem in cattle and may lead to death. Moreover, the disease is more severe in females and young animals. Mite infestation causes a highly contagious disease which can spread to animals sharing grazing areas and the environment with infested animals. Mites may be transmitted directly by contact or indirectly through objects such as the harnessing materials, saddle, bedding and tree trunks (Lawal and Ameh, 2007 and Megersa, 2014). Close contact with cattle, particularly at watering points, could be responsible for increased exposure during the dry period. Moreover, feed shortages that reduce the immunity of the animals may also account for the increased prevalence and severity of the disease during the dry periods (Tefera and Getachew, 2012).

The preferred site of the burrowing mite of the genus *Demodex* is at the sebaceous glands of the skin and hair follicles. These follicular mites mainly lived as commen sals in the skin. In some animals, these mites may cause mange, which leads to causing economic loss (Islam *et al*., 2006). The occurrence of mange mite depends on the following factors. In wet season cattle mange mites is higher relative to dry season (Megersa,2014). The

economic significance of mange infested animals arose from decreased body weight, therapy costs, skin deterioration due to perforation of the skin and intense pruritus as skin lesions may cover nearly the entire body, and occasional mortalities in untreated and young animals (Singh, 2005). Mange can severely compromise the welfare of milking animals by increasing susceptibility and reducing their vitality to other diseases as are sult of secondary bacterial infection. During the development of mange, itchiness distracts the animals from eating, so that they often become emaciated. Mange mite infestation can cause alopecia, dry erythma, and rough hair coat with crust formation in cattle(Bhagat *et al*.,2017). The majority of the lesions is confined to the integument and comprises anemia, hyperkeratosis, general loss of productivity and body weight (Jarso *et al*., 2018).

Variation in the prevalence of mange mite infestation based on factors like site of attachment, sex, age, body condition, and herd size was reported. For instance, the lesions of mange mite infestation were reported most commonly on the head, neck, abdominal regions, inner surface of the thighs, and inguinal region of infested cattle. Cattle mange mite infestation generally starts in the head region, extending through the neck to other areas with thin skin, such as the penile sheath and the udder. The whole body may become infested within a month. Also, cattle mange infestation commences at areas of thin skin: the head, base of the neck, udder, prepuce, and flank. The head becomes affected rapidly in every case because the animal uses its teeth to scratch the affected areas (Walker *et al*., 2003).

A higher prevalence in female cattle than in male cattle was reported and its finding was associated with a higher level of prolactin and progesterone hormones that could make the females more susceptible to infestation. Additionally, pregnancy and lactation stress could also aggravate the susceptibility of the female cattle (Feyera *et al*., 2017, Megersa *et al*., 2012 and Regassa *et al*., 2015). Higher prevalence in cattle with poor body condition (Walker *et al*., 2003) may be attributed to severe allergies and itching due to the outcome of histamine liberated from damaged body cells, which are compelling allergens (Acha and Szyfres, 2003). Furthermore, trypanosomasis, worm burden, and poor nutritional status can all be risk factors for *Sarcoptic* mange (Parsani and Veer Singh, 2008).

The higher prevalence of mange mite infestation in cattle with a herd size of more than40 indicates that cattle with a herd size of less than 20 (twenty) and between 20 (twenty) and 40(forty). This could be attributed to the fact that cattle from large herd sizes are more prone to being exposed to diseased animals due to the contagious nature of mite infestation. Contact during herding, housing, and suckling is the most important means of transmission. Contact beddings and cattle rub themselves on tree trunks, leaving the mites where the next animal may pick them up when rubbing on tree trunks, which are the other sources of transmission (Megersa *et al*., 2012 and Feyera *et al*., 2017).

Since dairy cattle are usually kept indoors and in close proximity, this contact favors transmission of the causative agent of mange and hence easy establishment of the disease in the herd. As herd size increases, the prevalence of *S. scabie* also increases significantly (Feyera *et al*., 2017). Therefore, considering the zoonotic importance and the great economic impact of *Sarcoptes scabiei* on cattle production and productivity, more detailed investigation into the epidemiology, economic significance, and species composition of this disease should be conducted to design and implement an effective control program and improve cattle production and productivity (Walker *et al*., 2003). High mange mite infestations are generally observed during the rainy season, in young cattle, in cattle with poor body condition, and in large herd sizes (Jarso *et al*., 2018). Ticks are hematophagous arthropods belonging to class Arachnida. These are major vectors of pathogens in animals and humans. Most importanttick species reported to infest cattle in Nigeria belong to genera *Ambylomma, Hyalomma,* subgenus *Boophilus* and *Rhipicephalus* (Kiros*et al*., 2014 and Kamal *et al*., 1996).

The occurrence of ticks in cattle was associated with factors like age, sex, body condition, herd size, herd composition and season which affect mean tick burden of cattle (Sajid *et al*., 20008).Wet season, high humidity and high temperature; facilitate the growth and survival of tick at all different developmental stages (Latif and Walker, 2004). Ticks are one of the most serious ectoparasites in Nigeria. These causes the greatest economic losses in livestock production and productivity. The main effect of tick infestation in animals includes mild to severe anemia, loss of appetite, leading to a

reduction in growth rate and decreased productivity. Additionally, ticks are responsible for direct damage to the cattle through their feeding habits, damage to udders, teats and scrotum (Wall *et al.,* 2011).

The specific site of tick attachment is one of the population limiting systems that operate through the restriction of tick species to certain parts of the host body. The ticks grab on to the hosts using their front legs and then crawl over the skin to find a suitable place to attach and feed (Latif and Walker, 2004). Depending on the tick, site preference on the host depends on the accessibility for attachment, to get blood, and protection to overcome the environmental damage that inhibits its existence and grooming activity (Wall and Shearer, 1997).Tick infestations in cattle were reported from different parts of the country with different prevalence ranging from 28.5% to 100% (Wall *et al.,* 2011 and Regassa *et al*., 2015).

Ticks are one of the major ectoparasites affecting the health and productivity of cattle in Nigeria. The prevalence of tick infestation in cattle varies from one site to other in Nigeria. Factors like age, sex, body condition, herd size and herd composition also affect the prevalence and burden of ticks in cattle. The prevalence and burden of tick infestations were affected by various factors. For instance, some studies revealed that male cattle carried significantly more ticks than females, which was suggested to be due to the fact that female cows are restrained for daily milking, and during this time the milkers might remove ticks by hand, and this could lead to a gradual reduction in the average tick load. Similarly, some authors reported that the higher prevalence in adult cattle was probably attributed to the fact that adult cattle do not lie on the ground for much of their time but search the higher plant strata for their feeding, whereas the young ones lay on the ground for a longer period of time and easily acquire tick infestation (Megersa *et al.,* 2012).

Furthermore, a higher tick burden was reported on cattle with poor body condition than on those with other body condition scores. This was due to the fact that the resultant worry due to tick attachment might interfere with feeding and lead to loss of condition (Megersa *et al*., 2012). Also, many reports indicate that when the cattle herd size increases to more than 40, the average tick load increases. In both conditions, there is temporary crowding at grazing areas and watering points, which could facilitate the attachment and infestation of ticks and increase the infestation level. Frequent contact among cattle, cattle, and small ruminants sharing the same grazing area might also contribute to the abundance of *Rh. pulchellus* and *Am. variegatum* (Feyera *et al.,* 2017).

Herd composition is also the other factor that affects tick burden in cattle. Cattle kept and grazing mixed with small ruminants were reported to harbor more tick burden (Megersa *et al*., 2012). According to Regassa et al. (2015), the main tick attachment sites were the anal area, brisket, and scrotum in males and the udder in females. A similar report was provided (Yacob and Yalew, 2008). These sites provide the highest moisture, favorable for growth, and the skin is easily penetrated for sucking blood (Regassa et al., 2015).

Fleas are insects forming the order Siphonaptera. They are wingless, with mouthparts adapted for piercing skin and sucking blood. Fleas are external parasites, living by hematophagy of the blood of mammals and birds. Historically, fleas are among the most important ectoparasites of humans in that several species are the natural vectors of several important infectious diseases, like plague. Today, some 15 families with a total of about 220genera and some 2,500 species of fleas were described (Shiferaw, 2018). Of the 2500 species described to date, over 70% are parasitic on rodents.

Fleas feed on blood and adult fleas remain permanently on their host but usually move around upon it and feed periodically. However, fleas like the 'stick-tight fleas' such as the rabbit flea, *Spilopsyllus cuniculi*, tend to remain attached for long periods of time after firmly anchoring themselves in place with their mouth parts. Movement of adult fleas between hosts occurs when there is close physical contact. The sexes are separate and male fleas are alleged to have the most complex genitalia in the animal kingdom. Most fleas are associated with a particular host species but this is seldom a highly specific relationship and a hungry flea is liable to feed on any warm-blooded animal. Flea bites can prove intensely irritating and in sensitive individuals and domestic animals they induce flea-bite dermatitis (Gunn and Pitt, 2012). Information on flea infestation in cattle is not yet documented sofar from other country as well as in Nigeria.

Lice are small wingless insects with dorso-ventrally-flattened bodies which are classified into

a single order (*Phthiraptera*) and intwo suborders namely, *Anoplura* (sucking lice) and *Mallophaga* (chewing/biting lice). Approximately, 540 valid species of sucking lice are recognized, all of which are obligate hematophagous ectoparasites of mammals. Although only about 20of these species are pests of domestic animals, they can occur in huge numbers which may result in host irritation, anemia or dermatitis (Shiferaw, 2018 and Taylor *et al.,* 2016). Biting lice graze on epidermal tissue, hair and other organic waste. They cause intense itching by their feeding and egg laying activities. Sucking lice have a narrow head with mouthparts adapted for penetrating the skin of the host and sucking blood. Both immature and adult stages suck blood or feed on the skin. The sucking louse of the cattle, *Microthoracius* is an obligate parasite which seems to be species specific.

Lice spread to non-infested animals by close contact, either direct or via fomites but the parasite does not survive long off its host. Lice may occur anywhere on the body of affected cattle but are often first seen on the shoulder and neck areas(Wall *et al.,* 2011). Mouthparts are adapted for sucking blood and tissue fluids, and, if large numbers of lice are present, considerable irritation can be caused by feeding and by their claws digging into the skin (Shiferaw, 2018). The saliva and feces of lice contain substance scapable of causing allergies giving rise to severe irritations to the skin. This is usually shown by the animal rubbing itself against objects. Lice infestations are associated with development of cockle. Cockle is an inflammatory response of the skin to the presence of lice and their saliva. This is seen after the wool or hair has been removed from the skin.

Animals in poor body condition are likely to be seriously affected (Pence, 2002). Generally, infested cattle may stop feeding and bite, rub, or scratch affected areas. Unthriftiness, matted, dull fleece, or tufts of wool may indicate lice infestation. Milk production may decline as a result, and the coat may becomes haggy and matted. There are only a few previous reports on the prevalence of lice infestation in cattle in Nigeria. The study reports indicated that cattle lice infestation is also another ectoparasite affecting cattle in Nigeria.

Many species of flies can pose threats to animals by their direct effects and by the transmission of pathogenic agents from one animal to another. Flies are also important vectors of humans' and animals' zoonotic diseases. Veterinary-important biting, non-biting and larvae-producing files of cattle, wild animals and other domestic animals indicated (Table 1) are present in different parts of the world as well as in Nigeria (Taylor *et al.,* 2016). The presence of flies on cattle can cause considerable health and economic importance in cattle production. Biting and nuisance flies cause irritation and, if prolonged, may prevent birds from feeding, inevitably leading to decreased productivity.

Biting flies pose a particular risk to cattle in trypanosomiasis-endemic areas if they are knownto be mechanical vectors of *Trypanosoma evansi* (Mitchella *et al.,* 2012). Biting flies are common in cattle. Among biting flies, horse flies (*Tabanus*) and stable flies (*Stomoxy*) are hematophagous flies (Ahaotu *et al.,* 2020) which are responsible for mechanical and non-cyclical transmission of trypanomosis in cattle. in different parts of the world (Walker *et al.,* 2003). *Trypanosoma evansi* incattle. Cattle are transmitted mechanically by the bites of hematophagous flies such as *Tabanus* and *Stomoxys*. The most important biting flies for transmission of *T. evansi* are species of the genus *Tabanus* (Loomis, 1986). It's the major problem for the occurrence and transmission of trypanosomasis in areas outside of the tsetse fly belt in Africa as well as in Nigeria (Mitchella *et al.,* 2012). Biting flies can cause severeirritation in domestic animals, and they are vectors for bacteria, viruses, spirochetes and chlamydia.

However, because they feed on blood, they canalso cause anemia and hypersensitivity (Walker *et al*., 2003). Only a very few reports are available on the biting flies of cattle from Nigeria. Non-biting flies include the face fly, head fly, and house fly. Non-biting flies may feed on these cretions from the eyes, nose, and any small wounds. This distracts animals from grazing, causing a reduction in growth and productivity. Non-biting flies are not key biological vectors of any specific disease organisms, but because of their feeding and reproduction habits and the structure of their feet and mouthparts, they can act as mechanical vectors for a whole range of pathogens, from viruses to helminthes (Agrawal and Gupta,2010). The cattle nasal botfly, *Cephalopina titillator* (Diptera: Oestridae), occurs worldwide (Yakhchali and Hosseini, 2006). Nasopharyngeal myiasis caused by Oestridae is very common.

The cattle nasal bot (*Cephalopina titillator*) is usually found at necropsy or during meat

inspection (Sazmand and Joachim, 2017). It causes nasopharyngeal myiasis in cattle and results in cattles' health hazards and severe economic losses in the cattle industry (Hanem *et al.,* 2013). The adult fly deposits larvae as obligate parasites of cattle in the nasal cavity, which is known to parasitize the animal for a substantial period of time (Rahman *et al*., 2001), where it causes irritation of the nasal cavity and predisposes the cattle to secondary bacterial infections and is usually found at post-mortem inspection (Yakhchali and Hosseini, 2006). It also impairs animal welfare, reduces host physiological functions (Sohrabi *et al*., 2013),destroys host tissues and causes significant economic losses through reductions in milk production and losses in terms of weight gain (Duaa *et al*., 2015).

Several factors contribute to infestation by Cephalopina titillator, including the free movement of cattle between different localities due to the lack of closed-farm systems for cattle breeding; the absence of strict control methods on imported animals; and the absence of specific and sensitive techniques for routine diagnosis of infestation in living cattle (Sanjay *et al.,* 2007). Reports from different study areas indicated that *Cephalopina titillator* is also another ectoparasite affecting cattle in Nigeria.

Various studies reported that female cattle were found to harbor the larvae of *C. titillator* when compared to male cattle (Kissi and Assen, 2017; Mumed and Gemeda, 2015). This wasdue to the fact that female cows were kept not very far from the villages, even during the dry season, because they supplied milk for the family, which was supposed to expose female cows to heavier fly challenge in the valleys near the villages. On the other hand, the males move far from fly challenge areas due to the course of continuous movement as pack animals.

Moreover, female cows are under continuous stress, which may suppress their immunity (Yakhchali *et al.,* 2011). On the other hand, Milnes *et al*. (2003) have reported that the rate of larvae infestation was significantly higher in males than female cows. This study failed to clearly indicate or suggest why the male cattle were more infected than females. However, other authors argue that these variations could be due to the differences in management practices of nomads (Zintl *et al.,* 2003 and Regassa *et al*., 2015). Normally, the owners use the bulls for transportation. It happens that male bulls make journeys of hundreds of kilometers and visit many new places, so they are easily exposed to new epidemic areas of *C. titillator* (Zintl *et al.,* 2003). A higher prevalence of *C. titillator* in the old group of cattle than in young (yearlings less than 7 years old) cattle and adult (cattle greater than 7 years old) cattle was reported in Nigeria. This was suggested to be due to the fact that older cattle may be more tolerant to flies and allow the deposition of a higher number of larvae around the nostrils, while the younger cattle actively seek to prevent the flies settling around the nostrils (Roy *et al.,* 2001).

Cephalopina titillator: higher infestation was reported in cattle with poor body condition than in those cattle with both medium and good body condition scores (Kissi and Assen 2017, Mumed and Gemeda, 2015 and Regassa *et al.,* 2015). It was argued that it might be due to the interference of larval infestation with feeding behavior of cattle and respiration, which leads to starvation and lack of oxygen to cells and tissue. It was also suggested that *C. titillator* larvae infestation has a severe impact on the body condition of cattle and causes losses in terms of body weight gain. In addition, it was reported that *C. titillator* larvae infestation has several negative impacts on respiratory function, feeding, health, and productivity of cattle, which lose their appetite and show respiratory problems and abnormal behavior resembling cranial coenuriasis (Kissi and Assen 2017). Several studies have revealed that *C. titillator* is one of the most common ectoparasites of cattle in Nigeria.

Clinical features of ectoparasite infestation in cattle include pruritic dermatosis with papules, crusts, anemia, excoriation, secondary alopecia, and lichenification. The lesions tend to occur on the face, neck, shoulders and across the rump, especially in cases of lice, fleas and mange mite infestations (Wernery, 2002). Hemorrhage, collagen degeneration, and a wedge shaped area of necrosis can occur due to tick mouth parts penetrating the epidermis and becoming lodged in dermis. Tick feeding can introduce cutaneous bacteria into the skin, causing abscesses, or into circulation, leading to bacteraemia and septicemia (Taylor *et al.,* 2016; Wall and Shearer, 1997).

Biting flies, particularly stable flies, horn flies, and tabanids can cause severe disturbance (Ahaotu *et al*., 2019) and annoyance to cattle, leading to reduced weight gain, reduced milk production and hide damage. Fly bites may cause pruritic papules and wheals. Blood-feeding flies may also be important pathogen vectors (Agrawal and Gupta,

2010). The activity of nuisance flies, such as face fly, houseflies and other muscids leads to disturbance and irritation. These flies may also be mechanical vectors of disease (Wernery, 2002). Irritation, bleeding from nostrils, fever, emaciation, loss of appetite, congestion of mucous membrane, enlargement of lymph nodes, nasal discharge, lack of coordination (neurological signs), increased respiratory rate, frequent sneezing and snoring during breathing were most common clinical signs of *Cephalopina titillator* infestation. It leads to reduced production of milk and body weight gain in cattle (Tareq et al., 2018).

Diagnosis of ectoparasites infestation or ectoparasite-associated dermatosis requires knowledge of the parasite involved and its lifecycle. This can be achieved in many cases, including direct collection of the parasites or examination of an animal's hair. For instance, lice live in an intimate relationship with the host's skin and can easily be found there (Table 2). However, visiting ectoparasites, such as biting flies, may be on the skin for only a short period of time each day, and a diagnosis is often made by implication. Hence, knowledge of the clinical signs of skin disease is usually required (Wernery, 2002). Examination of *Cephalopina titillator* larvae in cattle can be carried out by using a postmortem after the cattle are slaughtered. The larvae of the parasites were detected after dissection and gross examination of the heads of cattle, including the nasal cavity, frontal sinuses, turbinate bones, and nasopharynx for the presence of *C. titillator* larvae. Diagnosis of this parasite is very difficult in living animals (Regassa *et al.,* 2015).

Early detection and taking major action is important rather than waiting until the problem of ectoparasites becomes serious. At least once a week, thorough physical observation of animals by their owners is important. Owners need to run their hand over each animal's hair coat, visually inspecting for excessive hair loss, flakes of loose skin, areas of skin irritation and any crusty lesions or bumps that might indicate infestation with ectoparasites. Immediately separate and confine any animal that shows signs of ectoparasite infestation or seems to be unthrifty. It helps to reduce chances of transmission of ectoparasites to rest of their animals. Quarantined animals should not be mixed with main herd until treatment is complete and ectoparasites are eradicated. Isolate newly introduced animals and treat them for ectoparasites before mixing them with other animals (Desta *et al*., 2010).

Table 1. List of biting, non-biting, and larvae of flies with veterinary importance to Cattle, domestic animals, and other wild Animals

Family	Genus	Species	Common name	Host	Type of flies
Hippoboscidae	*Hippobosca*	*Camelina*	Cattle fly	Cattle	Biting
Oestridae	*Cephalopina*	*titillator*	nasal botfly	Cattle	Myiasis
Tabanidae	*Tabanus*	*T. fuscicostatus andT.atratus.*	Horse fly	All animals	Biting
Muscidade	*Stomoxys*	*Calcitrans*	Stable fly	All animals	Biting
Muscidae	Musca	*Autumnalis*	Face fly	All animals	Non biting
Muscidae	Musca	Domestica	House fly	All animals	Non biting
Glossinidae	*Glossina*	*Fusca,morsitans*			
Palpalis			Tsetse Flies	All animals	Biting

Table 2. Diagnosis of Ectoparasites and Laboratory Examination Techniques

Ectoparasites	Name Anatomical site	Laboratory Techniques for	Examination
Mites	Hair, Epidermis Skin scraping, Acetate strip,	hair follicle, surface, hair plucks, hair brushings, serology and Biopsy	
Lice	Hair Skin scraping,	hair plucks and	Acetate strip
Fleas	Hair,surface,	Environments hair plucks and hair brushings	
Ticks	Surface,	Environments	Visual examination
Flies	Surface,	Environments Biopsy, observation whilst feeding and	Postmortem examination

Ectoparasites can be controlled by treatment of affected animals. As a strategic treatment approach during two seasons is vital. Treatment during dry period reduces overall stress on animals associated with malnutrition and further prevents occurrence of concurrent infections. Secondly, wet season treatment is helpful to prevent re-infestations and propagation of different stages of ectoparasites or hinder life cycles of ectoparasites (Yakhchali *et al.,* 2011). As elected drug for ectoparasites is insecticides oracaricides, while ivermectin given as a subcutaneous injection is a drug of choice for sarcoptic mange treatment. Infested and sick animals may be treated with effective curative agents like Cymerlarsan and quinapyramine methyl sulfate.

Treatment of ectoparasites should be viewed not only in terms of curing sick animals, but also in terms of improving body conditions and enhancing body defense (Yakhchali *et al.,* 2011).Ticks, fleas, lice, and flies are arthropods that live all over the world and infest all types of wild and domestic animals, as well as humans (Jongejan and Uilenberg, 2004). Arthropods are important for the maintenance and transmission of many pathogens, including several species of bacteria, viruses, protozoa, and helminthes, causing diseases in humans, pets, and domestic animals world wide (Billeter *et al.,* 2008). Vector-borne diseases cause significant morbidity and mortality in both humans and animals around the world and affect the global economy, representing approximately 17% of the burden of all infectious diseases (Dantas-Torres *et al.,* 2012).

Ticks and biting flies are the major causes of vector-borne diseases in cattle. The common vector-borne diseases in cattle are Theileriosis, Babesiosis, Anaplasmosis, and Trypanomosis. These vector-borne diseases are caused byorganisms like *Theileria, Babesia, Anaplasma*, and *Trypanosoma evansi*, respectively (Mohammed *et al*., 2017). The former three diseases are transmitted biologically by different species of ticks, and the latter two are transmitted mechanically by biting flies, mainly *tabanus* and *stomoxy. Babesia caballi* was molecularly detected from Sudanese cattle by Abdelrahim *et al*. (2009) using Reverse Line Block (RLB). Both *Babesia caballi* and *Theileriaequi* were molecularly confirmed in cattle from Iraq using PCR (Jasim *et al.,* 2015).

Trypanosoma evansi is a common protozoan disease that affects cattle in different parts of Northern Nigeria thatare not tsetse fly belt areas (Jilo and Abdela, 2017 and Kassa *et al*., 2011). Information on vector-borne diseases, namely *Theileria, Babesia* and *Anaplasma*, in cattle is not available so far from Nigeria. Only a preliminary report on *Theileria mutans* in cattle was reported from Northern Nigeria. This report can help plan long-term tick and tick-borne pathogen control strategies in the study area and neighboring areas with similar socio-ecological characteristics (Rodighiero *et al.,* 2012).

Conclusion

In Nigeria, the contribution of cattle to the economy of pastoralists is high when compared with other livestock species. However, ectoparasites and associated pathogens are still one of the major constraints to the productivity, production, and health problems of cattle. Ticks, mites, and myiasis producing flies, especially Cephalonia titillator, are among the major health problems of cattle in Nigeria. Ectoparasites are also responsible for the transmission of highly pathogenic agents to cattle. Ectoparasites ofcattle are currently responsible for considerable economic losses due to the degradation of skin quality, reduced productivity, and performance of the animal in Nigeria. The prevalence and burden of ectoparasites in cattle is affected by different risk factors such as poor management, season, herd size, herd composition, co-infection, poor nutrition, and hygienic conditions.

Therefore, improving husbandry practices and veterinary services may reduce the level and burden of ectoparasites in cattle. The economic losses due to ectoparasites in cattle result in a reduction in productivity, decreased reproductive performance, and the death of the affected animals. Overall, this review showed that ectoparasites are important problems in cattle of all age groups, body condition scores, both sexes, and different agro-ecological zones and harbor a considerable level of ectoparasites, which warrants the institution of appropriate control strategies to improve the health and productivity of cattle.

Based on the above conclusion, the following recommendations are forwarded:

-Appropriate control interventions need to be implemented to reduce the negative impacts of ectoparasites on cattle in Nigeria.

-Awareness creation about the economic

importance of ectoparasites of cattle in Nigeria is very important.

-Improving husbandry practices and veterinary services that help to reduce the level of ectoparasites is urgently needed. In-depth studies on ectoparasites and associated pathogens of cattle should be conducted indifferent parts of Nigeria.

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