REVIEW OF THE PREVALENCE OF GASTROINTESTINAL NEMATODES IN RUMINANTS ACROSS TROPICAL AFRICA

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Abstract

Gastrointestinal nematodes (GINs) are undoubtedly one of the biggest challenges to livestock productivity in tropical Africa, with high prevalence, pathogenic impacts, and significant economic losses. This review aims to compile available information on the presence, spread, primary agents, detection techniques, causes, and issues related to drug resistance in GINs in domestic ruminants in this region. Surveys conducted across various countries in West, Central, East, and Southern Africa reveal prevalence rates often exceeding 70%, with a predominant presence of Haemonchus contortus. The dynamics of infestations are mostly influenced by geographical and seasonal variations, different diagnostic methods, and extensive livestock systems. Moreover, it is noted that resistance in NGI is increasing against the main classes of anthelmintics, and in several areas, this trend indicates that treatment efficacy is at risk. Accordingly, some recommendations are provided on how to achieve integrated control through epidemiological surveillance, standardized diagnosis, sustainable pasture management, targeted treatments, and genetic selection of resistant animals. This review emphasizes the urgent need for coordinated efforts to better control NGI and improve ruminant health and productivity in tropical African conditions.

Key words: *gastrointestinal nematodes, prevalence, ruminants, and tropical Africa*

INTRODUCTION

Ruminant livestock production is the main source of income for the agricultural sector and the rural economy in Africa. Cattle, sheep, and goats are among the many animals that play vital roles in food security, income generation, and the socio-cultural and religious activities of communities [4]. However, the development of the livestock sector still faces serious health obstacles due to several disease constraints. Among these, parasitic diseases of the gastrointestinal tract remain the most problematic, as they pose significant threats to animal health and human disease [3, 11] Gastrointestinal nematodes (GINs) are internal parasites that infest the digestive tracts of ruminants, causing a range of clinical and subclinical symptoms, including anemia, weight loss, diarrhea, reduced growth and milk production, and overall immunosuppression [14, 16]. In tropical Africa, the most commonly reported genera include *Haemonchus, Trichostrongylus, Oesophagostomum, Cooperia*, *Strongyloides*, and *Bunostomum* [1, 15]. The agroecological conditions specific to the tropical regions of Africa are characterized by alternating wet and dry seasons, high temperatures, and high

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The manuscript was received: 02.06.2025
Accepted for publication: 15.07.2025

humidity—are ideal for the survival and transmission of larval stages of these nematodes [3, 7]. Additionally, the predominantly extensive livestock systems, herd mobility, low veterinary coverage, and poor use of anthelmintics all contribute to the persistence and spread of infestations [5, 14]. Currently, one of the major challenges is the rapid and widespread emergence of anthelmintic resistance, especially among *Haemonchus contortus* populations, which is a dangerous blood-sucking parasite of small ruminants [8, 14]. This resistance, which is well documented in some parts of sub-Saharan Africa, hampers conventional chemical control methods and worsens economic losses [5]. While many studies at local and national levels have investigated the prevalence of GIN in ruminants, the data available are scattered, inconsistent, and difficult to compare due to varied methodologies—such as differences in coprological diagnosis types, collection seasons, sample sizes, and sample selection. As a result, there is a lack of regional trend analyses and a comprehensive global perspective to prioritize health interventions. Therefore, it is essential to systematically synthesize existing research on GIN prevalence in tropical Africa to identify the most common parasite species, map their distribution, understand geographical and seasonal variations, and highlight key risk factors. This review aims to critically analyze published research findings while shedding light on the challenges faced in implementing eco-friendly control measures for these parasites in tropical livestock systems.

REVIEW METHODOLOGY

Document research strategy

A structured narrative review was conducted to compile all existing epidemiological data on gastrointestinal nematodes (GINs) in ruminants in tropical Africa. The literature search was performed between [month, year] and [month, year] using various online scientific databases, including PubMed, Google Scholar, Scopus, ScienceDirect, and African Journals Online (AJOL). Additionally, the websites of local and international organizations (FAO, ILRI, and OIE) were searched for potential technical reports or gray literature. Keywords were combined using the Boolean operators "AND" and "OR," such as ruminants OR cattle OR goats OR sheep, Africa OR Sub-Saharan Africa OR tropical Africa, prevalence OR epidemiology OR infection rate. The French equivalents of these keywords were also used to expand coverage of French-language sources: gastrointestinal nematodes AND prevalence AND ruminants AND Africa.

Inclusion and exclusion criteria

The articles were selected based on well-defined inclusion criteria: studies published between 2000 and 2025; conducted in countries located in tropical Africa (intertropical zones of West, Central, East, and Southern Africa); focusing on domestic ruminants such as cattle (*Bos taurus, Bos indicus*), sheep (*Ovis aries*), and goats (*Capra hircus*); explicitly reporting prevalence rates of NGI (via coprological, larvoscopic, or necropsy diagnosis); being cross-sectional, longitudinal, or epidemiological surveillance studies; and available in full text in English or French.

Exclusion criteria included: Studies solely on parasites other than NGI (e.g., coccidia, cestodes, protozoa); Experimental laboratory studies or clinical trials not related to prevalence; Studies without usable quantitative data; Literature reviews not accompanied by original data.

Study selection and analysis process

All identified articles were exported to a reference management software (Zotero). Duplicates were manually removed. The screening process involved two steps: first, screening titles and abstracts for pre-selection based on the criteria mentioned above; second, reading the full text of the selected articles to confirm eligibility. For each included article, the following data were extracted and entered into Excel: reference (author, year); country and region; host species; diagnosis method; number of animals tested; overall prevalence and prevalence by parasite species; nematode species identified; and investigated risk factors (age, sex, season, etc.).

Methodological limitations

It is important to highlight that methodological differences between studies (such as diagnostic techniques, study period, and sample size) may affect result comparability. Without strict standardization, regional averages were interpreted cautiously.

RESULTS AND DISCUSSION

Geographic distribution of studies

A total of 20 studies meeting the inclusion criteria were selected, covering different countries in tropical Africa, primarily in West Africa (e.g., Nigeria, Ghana, Burkina Faso), East Africa (e.g., Kenya, Ethiopia, Uganda, Tanzania), and to a lesser extent, in Central Africa (e.g., Cameroon, Democratic Republic of Congo) and Southern Africa (e.g., Zambia, Malawi). Most studies originate from countries with the highest livestock density and active university veterinary programs, such as Nigeria, Kenya, and Ethiopia, which together account for over 50% of the publications. Conversely, some countries in the Sahelian or equatorial zones remain underrepresented or absent altogether, highlighting an imbalance in the continent's epidemiological coverage. This uneven distribution poses a major challenge for accurately mapping NGI across Africa.

Overall prevalence of NGI in ruminants

The prevalence of NGI in ruminants varies greatly depending on the region, animal species, and methods used. Reported prevalence rates range from 20% to over 90%, with a weighted average estimate of about 65–75% across all studies examined.

In goats, the prevalence is generally the highest (mean 76%), followed by sheep (70%) and cattle (58%). This pattern is partly explained by the greater susceptibility of small ruminants to certain blood-sucking species such as *Haemonchus contortus*, but also by their feeding practices that are closer to the ground (low grazing), which increases the likelihood of ingesting infesting larvae [1, 8].

A clear seasonality is observed: most studies report higher infestation rates during or just after the rainy season, a period that favors the survival and migration of larvae into the external environment [3, 7].

Among these parasites, *Haemonchus contortus* is the most pathogenic and prevalent in warm, humid tropical areas. Several studies [15, 16] report it with a prevalence exceeding 80% in small ruminants, strongly associated with anemia cases, especially as detected by the FAMACHA index.

Key interpretations

Such research covers various situations in tropical Africa, mainly focusing on East Africa, including Ethiopia, Kenya, and Rwanda, and West Africa, especially Nigeria, with limited data from North and Central Africa. The incidence of NGI is generally high, especially in small ruminants, with rates ranging from 40% to 85% depending on the region and time period. *Haemonchus contortus* is one of the most commonly mentioned parasites, often at the top of lists. Other frequently mentioned species include *Trichostrongylus, Strongyloides*, and *Trichuris ovis*. Diagnostic methods vary significantly between studies, including simple coproscopy, McMaster tests, larval cultures, or even post-mortem dissections. Seasonal effects are noted, with increased occurrence after the rainy season in countries like Nigeria, Ethiopia, and Kenya. The prevalence of parasitic agents varies among animal species: it is very high in goats and sheep, moderate in cattle, especially in semi-arid or North African regions.

Nematode species identified

The identified nematode species are presented in Table 1 and 2..

Table 1: Most frequently encountered nematode species in the studies analyzed

Parasitic species	Family	Affected ruminants	Distribution
Haemonchus contortus	*Trichostrongylidae*	Sheep, goats, cattle	Very common in hot and humid areas
Trichostrongylus spp.	*Trichostrongylidae*	All	Temperate and humid tropical zones
Oesophagostomum spp.	*Strongylidae*	Cattle, goats, sheep	West and Central Africa
Strongyloides papillosus	*Rhabditidae*	Small ruminants	Common in marshy areas
Cooperia spp.	*Trichostrongylidae*	Cattle especially	Present but often underestimated
Bunostomum spp.	*Ancylostomatidae*	Cattle and sheep	Sporadic presence

Discussion

Results from various studies across several tropical African countries show a high prevalence of gastrointestinal nematodes (GINs) in domestic ruminants, especially in small ruminants like sheep and goats. The overall prevalence varies widely between countries, from 34% to over 90%, with an estimated continental average of 65% to 75%, highlighting the significant parasite problem in this region.

High prevalence: a widespread phenomenon

Most studies reviewed, whether local, regional, or from meta-analyses, emphasize a concerning prevalence of NGI infestations. For example, the meta-analysis by Regassa et al. [10] reported an average prevalence of 75.8% in small ruminants in Ethiopia, while Nwosu et al. [9] documented rates of 55.8% in goats and 43.1% in sheep in northeastern Nigeria. Similarly, in Nyagatare (Rwanda), a prevalence of up to 96% was observed in goats, which is exceptionally high. These figures demonstrate not only how widespread NGI are but also the significant health challenges they pose in the region.

Distribution by animal species

Globally, goats are the most affected species, followed by sheep and cattle. This could be explained by several factors. First, goats have a grazing behavior that makes them more exposed to the infesting larvae, which are located in the top few centimeters of the grass canopy [1]. Second, their immune system seems to be less effective against some nematodes, such as *Haemonchus contortus*. Cattle are less affected, possibly because their natural immunity is stronger or because the health management on cattle farms, which are often better organized than those of small ruminants, is more effective.

Table 2: Summary of studies on gastrointestinal nematodes of ruminants in tropical Africa

Author(s) & Year	Country	Animal species(s)	Sample size	Prevalence (%)	Identified parasitic species	Diagnostic method	Study season
Waruiru *et al*, 2001	Kenya	Cattle	300	65	*Haemonchus*, *Trichostrongylus*, *Oesophagostomum*	Flotation + larval culture	End of the rainy season
Bakunzi *et al*, 2010	South Africa	Goats	120	78	*Haemonchus contortus*, *Strongyloides papillosus*	Simple flotation	Dry + Rainy
Chiejina, 1994	Nigeria	Sheep, goats	450	84	*Haemonchus*, *Trichostrongylus*, *Oesophagostomum*	McMaster + larval identification	Wet season
Maingi *et al*., 1997	Kenya	Goats	200	81	*Haemonchus*, *Cooperia*, *Trichostrongylus*	Coproscopy + culture	Rainy
Mwendia *et al*, 2015	Kenya	Sheep	180	69	*Haemonchus contortus*, *Oesophagostomum spp.*	Flotation (McMaster)	Rainy
Zajac & Garza , 2020	Ethiopia	Sheep, goats	350	72	*Haemonchus*, *Trichostrongylus*, *Bunostomum*	McMaster + larvoscopy	Wet season
Nwosu *et al* ., 2007	Nigeria	Goats	500	90	*Haemonchus*, *Strongyloides*, *Oesophagostomum*	Coprologies + FAMACHA	Rainy season
Nginyi *et al* ., 2001	Cameroon	Cattle, Sheep, Goats	240	61	*Haemonchus*, *Trichostrongylus*, *Cooperia*	Flotation + larval culture	Rainforest
BiomedGrid / Ereje Town, 2017–18 (Ethiopia)	Ethiopia	Sheep & Goats	384	63.0	*Haemonchus contortus*	Coproscopy simple parasitological	2017–2018 (post wet/ dry)
Regassa *et al*., 2024 (Bahir Dar)	Ethiopia	Ovins	(unspecified)	34.4	*Haemonchus contortus*	Coproscopy	2024
Systematic review, 2016	Ethiopia	Sheep & Goats	>12,000	75.8 (CI 69.6–80.8)	11 genera, including *Haemonchus*, *Trichostrongylus*, etc.	Meta-analysis (various techniques)	2000–2015
Nwosu *et al*., 2002 (NE Nigeria)	Nigeria	Sheep & Goats	≈250	43.1 (sheep), 55.8 (goats)	*Haemonchus*, *Trichostrongylus*, *Strongyloides*, *Trichuris*, *Cooperia*, *Bunostomum*	McMaster + necropsy	2002 (dry & rainy seasons)
Meta-analysis Nigeria, 2020	Nigeria	Small ruminants	13,259 analytics	58.3 (CI 48.8–67.2)	Mainly *Haemonchus*, *Trichuris ovis*, *Strongyloides spp.*	coproscopy / review	1970–2016
Magadi division, Kenya (2004?	Kenya	Cattle, Sheep, Goats	262	69.2 (calves), 80.0 (goats), 82.0 (sheep)	Nematodes Strongyle-type (incl. *Haemonchus*, *Trichostrongylus*)	McMaster (fecal egg count)	Not specified
Tunisia (Tunis slaughterhouse) 2010	Tunisia	Cattle, Sheep, Goats	364 (sheep), 271 (goat), 152 (calf)	17 (sheep), 33.6 (goat), 7.2 (cattle)	*Haemonchus contortus* and *H. placei*	Post-mortem examination + morphometry	Jan–Jun 2010
Wukro, Ethiopia (sheep), 2014	Ethiopia	Sheep	384	40.9	*Haemonchus contortus*	Post-mortem	Not specified
Nyagatare, 2017–18	Rwanda	Goats	149	≈96 (strongyle-type)	STNs (*Strongyloides*, *Nematodirus*, *Trichuris*), coccidies	Flottation + McMaster	2017–2018

Author(s): main name of the author et al.; **Year**: year of publication of the study; **Country**: country where the study took place; **Animal species(s)**: species studied (cattle, sheep, goats); **Sample size**: total number of animals examined; **Prevalence (%)**: overall prevalence rate of GIN; **Parasite species identified**: genera or species specified in the study; **Diagnostic method**: techniques used (coproscopy, larval culture, FAMACHA test, etc.); **Study season**: time of year when the samples were taken; **Livestock system**: ruminant production method (extensive, semi-intensive, etc.)

Dominance of *Haemonchus contortus*

All studies agree on the dominance of *Haemonchus contortus* in epidemiology, a blood-sucking parasite causing severe anemia and significant losses, especially in small ruminants. Its prevalence often exceeds 70% in hot, humid regions like Nigeria, Ethiopia, or Kenya. Its high reproductive capacity, quick adaptation to climate, and growing resistance to anthelmintics make it a major pathogen [6, 14]. It is frequently found alongside other genera such as *Trichostrongylus, Strongyloides, Oesophagostomum*, and *Trichuris*, which adds to the clinical complexity and makes treatment more challenging.

Effect of seasonality

The impact of seasonality on NGI epidemiology is well understood. In tropical regions, the rainy season promotes the development of infective stages in the environment (eggs, L1, L2, L3), resulting in a significant increase in infections.

As shown in the review, studies like those of Maingi et al. [7] report a higher prevalence during the wet season, sometimes twice as high as in the dry season. This epidemiological pattern is important to consider when planning the timing of anthelmintic treatments, which are best administered just before or at the beginning of the rainy season.

Diagnostic methods: an obstacle to comparability

One of the main restrictions repeatedly highlighted in the studies is the variety of diagnostic methods used. Some studies relied solely on flotation techniques for simplicity; however, others employed quantitative methods like McMaster or conducted more precise post-mortem examinations. Additionally, only a few studies included larval culture to assist with gender identification in their research. This variation in methodology limits direct comparison of results and can lead to significant errors in estimating prevalence. Standardizing diagnostic protocols at the regional level would be beneficial.

Influence of the breeding system and health practices

Numerous studies agree that extensive livestock systems are directly linked to higher infestation rates. In these systems, animals are often in prolonged contact with contaminated pastures, and they are not rotated or dewormed strategically. The research by Waruiru et al. [15] clearly shows that semi-intensive farms have significantly lower levels of infestations compared to extensive ones. Additionally, misuse of anthelmintics contributes to the reemergence of resistance, particularly in *Haemonchus contortus*, which benefits the most. Recent studies in Ethiopia and Nigeria confirm that some herds relying solely on benzimidazoles or ivermectins have unsuccessful treatment outcomes.

Geographic disparities and limitations of available data

Although the review covers several countries in tropical Africa, large areas remain little or not studied, especially in Central Africa (Chad, CAR, Congo), in the Congo Basin, or certain parts of the Sahel. The available studies mainly come from Ethiopia, Nigeria, and Kenya. This uneven distribution is probably due to the concentration of universities and veterinary research centers in specific countries. It limits the continent's overall representation and highlights the need to broaden parasite surveys in underserved regions. Additionally, most studies are conducted on an ad hoc basis, while longitudinal surveillance would be better to track changes in infestations over time.

Implications for animal health and productivity

NGI causes a subtle yet significant decline in productivity, both through reduced zootechnical performance (growth, reproduction, milk production) and related mortalities, especially among young animals. Economically, indirect losses due to decreased animal value, lower fertility, and ongoing veterinary costs are substantial [11, 16].

Limits of available data

Several methodological limitations should be noted: Lack of uniformity in diagnostic methods (such as simple flotation, McMaster, larvoscopic techniques, etc.), which makes comparisons difficult; absence of standardization in collection periods; inequality in geographical coverage (some regions, like the Congo Basin or remote Sahelian zones, are under-studied); and reliance on outdated or ad hoc data (no longitudinal studies to monitor the actual evolution of infestations).

Operational recommendations

- **Parasitological diagnostic methods:** It is crucial to establish standardized diagnostic protocols that emphasize reliable quantitative techniques such as the McMaster method or Mini-FLOTAC, combined with larval culture, to enable precise and comparable monitoring of NGI infestations.
- **Strengthening epidemiological surveillance:** Conduct regular, geographically broad, and long-term surveys to track the progress of anthelmintic prevalence and resistance. Combining regional databases would help share information and support decision-making.
- **Implementation of integrated pest management strategies:** Combining rational pasture management (rotational grazing, avoiding high-contamination areas), genetic selection of resistant animals (local breeds adapted to the area), and targeted use of anthelmintics through tools like the FAMACHA test to reduce selection pressure on parasites.
- **Combating anthelmintic resistance:** Encourage rotation of different anthelmintic classes and promote the use of alternative methods such as herbal medicine and nutritional management to prevent the development and spread of resistance. Training veterinarians and livestock producers to detect and manage resistance early is crucial.
- **Awareness-raising and stakeholder training:** Create effective training programs for breeders and veterinary agents on good breeding practices, early symptom detection, prevention methods, and treatment strategies tailored to local conditions.
- **Institutional capacity building:** Assist local veterinary laboratories and research institutions in enhancing diagnostic capabilities, resistance monitoring, and evaluation of control strategies. Promote interdisciplinary and regional collaboration.

CONCLUSION

The review of studies from tropical Africa indicates that gastrointestinal nematodes are a major health threat to ruminant livestock, with a high prevalence of infections, especially in small ruminants. *Haemonchus contortus* is clearly the dominant parasite, with infestation rates exceeding 70%, highlighting its central role in herd health. Variations in prevalence across different animal species, locations, seasons, and livestock systems demonstrate the complex ecology of parasites in tropical regions. The strong seasonality linked to rainfall emphasizes the need to tailor control measures to the parasites' life cycle. The inconsistency in diagnostic methods used across studies serves as a significant obstacle to data comparison; therefore, establishing standardized tools is essential to ensure future surveys are more reliable. Additionally, the rise of anthelmintic resistance, particularly in *H. contortus*, presents new challenges for control strategies, making the rational and integrated use of antiparasitics the primary solution. Developing effective strategies involving various techniques such as epidemiological surveillance, diagnostics, pasture management, genetic selection for resistant animals, and alternative control methods is crucial, as these will help reduce the health and economic impacts of infestations. Training livestock producers and engaging regional veterinary institutions are pivotal in implementing these strategies. In conclusion, controlling gastrointestinal nematodes in ruminants in tropical Africa requires a combination of coordinated approaches based on scientific data to preserve animal health and improve livestock productivity in this vulnerable region.

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