Pakistan Veterinary Journal

ISSN: 0253-8318 (PRINT), 2074-7764 (ONLINE)
DOI: 10.29261/pakvetj/2026.237

RESEARCH ARTICLE

Global Prevalence of Fasciolosis in Sheep and Goats: A Systematic Review and Meta-Analysis of Epidemiological Patterns, Diagnostic Methods, And Climate-Associated Variation

Abel Villa-Mancera[1], José Manuel Robles-Robles[1], Jaime Olivares-Pérez[2], Agustín Olmedo-Juárez[3], Alejandro Córdova-Izquierdo[4], Roberto González-Garduño[5], José Luis Ponce-Covarrubias[6], Nallely Rivero-Perez[7], Felipe Patricio[1], Huitziméngari Campos-García[1], Juan Ricardo Cruz-Aviña[1] and Samuel Ortega-Vargas[1]

[1]Facultad de Medicina Veterinaria y Zootecnia, Benemérita Universidad Autónoma de Puebla, Tecamachalco Puebla, México; [2]Unidad Académica de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Guerrero, Ciudad Altamirano, Guerrero, México; [3]Centro Nacional de Investigación Disciplinaria en Salud Animal e Inocuidad (CENID SAI-INIFAP), Jiutepec, Morelos, México; [4]Departamento de Producción Agrícola y Animal, Universidad Autónoma Metropolitana, Unidad Xochimilco, CDMX, México; [5] Unidad Regional Universitaria Sursureste, Universidad Autónoma Chapingo, Teapa, Tabasco, México; [6]Escuela Superior de Medicina Veterinaria y Zootecnia No. 3, Universidad Autónoma de Guerrero, Técpan de Galeana, Guerrero, México; [7]Área Académica de Medicina Veterinaria y Zootecnia, Instituto de Ciencias Agropecuarias, Universidad Autónoma del Estado de Hidalgo, Hidalgo, México.
*Corresponding author: abel.villa@gmail.com

ARTICLE HISTORY (26-864)

Received: July 12, 2026
Revised: September 28, 2026
Accepted: October 28, 2026
Published online: October 31, 2026

Key words:
Fasciola gigantica
Fasciola hepatica
Fasciolosis
Goats
Liver fluke
Meta-analysis
Prevalence
Sheep
Small ruminants
Systematic review

ABSTRACT

Fasciolosis is an important parasitic disease of sheep and goats. This systematic review and meta-analysis summarized published prevalence estimates and explored geographic, diagnostic, and ecological variations. Five literature sources were searched for peer-reviewed reports published from 2002 to 2025, with findings synthesized separately for each host. Pooled prevalence was 15.3% in sheep and 10.4% in goats, but the prediction intervals were wide, and the evidence base was unevenly distributed across regions. Antibody detection, antigen detection, fecal egg examination, and post-mortem inspection measure different aspects of exposure or infection and therefore require separate interpretation. Substantial between-study variation and differences in sampling units limit the interpretation of the global summaries. The pooled values should be regarded as descriptive summaries of the available evidence rather than as uniform local risks. The findings support standardized diagnostic reporting and locally representative surveillance within region-specific One Health strategies.

To Cite This Article: Villa-Mancera A, Robles-Robles JM, Olivares-Pérez J, Olmedo-Juárez A, Córdova-Izquierdo A, González-Garduño R, Ponce-Covarrubias JL, Rivero-Perez N, Patricio F, Campos-García H, Cruz-Aviña JR and Ortega-Vargas S, 2026. Global prevalence of fasciolosis in sheep and goats: A Systematic Review and Meta-Analysis of epidemiological patterns, diagnostic methods, and climate-associated variation. Pak Vet J, 46(10): 2352-2368. http://dx.doi.org/10.29261/pakvetj/2026.237

INTRODUCTION

Fasciolosis is a trematodiasis caused by liver or bile duct flukes of the genus *Fasciola*, primarily *Fasciola hepatica* and *Fasciola gigantica*, which infect a wide range of vertebrate hosts, including domestic ruminants, equids, and humans (Mas-Coma *et al.*, 2009; Endalamew *et al.*, 2025). Among livestock, sheep and goats are highly susceptible because of their grazing behavior and limited acquired immunity to reinfection (Islam, 2021; Lan *et al.*, 2023). Fasciolosis causes substantial production losses through reduced weight gain, lower milk and wool production, liver condemnation, increased treatment costs, and mortality in cases of severe infections (Khademvatan and Majidiani, 2019; Schweizer *et al.*, 2005).

F. hepatica is widely distributed in temperate regions of Europe, the Americas, and Oceania, whereas *F. gigantica* predominates in tropical and subtropical areas of Africa and Asia. Both species use freshwater snails of the family *Lymnaeidae* as intermediate hosts. *Galba truncatula* is an important intermediate host of *F. hepatica*, whereas other lymnaeid species support transmission in different endemic settings (Mas-Coma *et al.*, 2022; Vázquez *et al.*, 2023). Temperature, moisture, hydrology, and management can influence local transmission by affecting the parasite and its snail hosts; broad climatic categories alone do not capture these conditions (Khan *et al.*, 2013; Villa-Mancera and Reynoso-Palomar, 2019).

Fasciolosis is a zoonotic public health concern. Human infection occurs mainly through the ingestion of

metacercariae from aquatic plants or contaminated water (Mas-Coma *et al.*, 2005). The One Health framework is particularly relevant because transmission is maintained through interactions among livestock reservoirs, lymnaeid snails, freshwater habitats, food and water practices, and human exposure. Contemporary One Health approaches emphasize the locally adapted integration of animal surveillance, environmental, and snail control, safe water and food practices, and human health interventions (Mas-Coma *et al.*, 2023).

Prevalence estimates vary with sampling design, diagnostic target, geography, and study period. Evidence extends beyond the settings emphasized in national syntheses from Africa and Asia. In Europe, harmonized coprological surveys have documented variations in farm-level *Fasciola* detection in sheep (Rinaldi *et al.*, 2015), and surveys have investigated fluke infection in German sheep and goats (Alstedt *et al.*, 2022). In the Americas, paired antibody and coproantigen ELISA results from Mexico illustrate the importance of distinguishing diagnostic targets (Villa-Mancera *et al.*, 2016). A survey in Papua New Guinea documented *Fasciola* in both hosts, providing evidence from Oceania (Koinari *et al.*, 2013). Recent global and regional syntheses likewise show marked geographic and methodological variations (Lan *et al.*, 2024; Nambuya *et al.*, 2025; Endalamew *et al.*, 2025). These studies broaden the geographic context but differ in their sampling units and outcomes. A global meta-analysis has already synthesized *Fasciola* prevalence in humans and domestic ruminants (Lan *et al.*, 2024); the present review therefore focuses on host-specific patterns in sheep and goats rather than claiming the first global synthesis.

The objectives of the present investigation were to (i) estimate the global pooled fasciolosis prevalence separately in sheep and goats; (ii) perform subgroup analyses by continent, diagnostic method, *Fasciola* species, reported data-collection period, sample size, and dominant climate class; (iii) explore between-study heterogeneity using univariate meta-regression; (iv) assess small-study effects/publication bias in the overall analyses; and (v) discuss the findings, uncertainty, and implications for surveillance, One Health control, and public health policy.

MATERIALS AND METHODS

Literature search strategy: The review process was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, 2020) guidelines (Page *et al.*, 2021). The search used five literature sources, consistent with the PRISMA flow diagrams: PubMed/MEDLINE, Web of Science (Core Collection), ScienceDirect, CAB Abstracts, and Google Scholar. The eligibility window covered peer-reviewed publications from 2002 to 2025, and eligible articles could report original data collected before 2002. The exact execution date of each database search and complete database-specific search logs were not prospectively archived, and this reporting limitation is acknowledged below. The review protocol was not registered prospectively. For reproducibility, the recoverable search documentation is reported as completely as possible; the exact execution dates and full source-specific syntax were not reconstructed retrospectively because they were not archived.

The core Boolean concept string was adapted to the syntax of each source: (*Fasciola* OR fasciolosis OR fasciolosis/fasciolasis OR liver fluke) AND (sheep OR ovine OR *Ovis aries* OR goat OR caprine OR *Capra hircus*) AND (prevalence OR incidence OR epidemiology OR survey OR seroprevalence). No language restrictions were applied during the initial search stage; however, only full-text articles available in English were included in the final analysis. The reference lists of eligible studies and relevant reviews were screened manually. Google Scholar studies were screened using the same eligibility criteria and were deduplicated with other studies by title, authorship, and publication year, with a manual check for ambiguous matches. The original authors were not contacted for additional data, and unpublished or gray literature was excluded. The inclusion and exclusion criteria applied during the study selection are presented in Table 1.

Table 1: Inclusion and exclusion criteria used for study selection.

Inclusion criteria	Exclusion criteria
Original prevalence data for *Fasciola* spp. in sheep and/or goats	Host species not specified
Clearly described diagnostic method (fecal examination, post-mortem inspection, ELISA, or molecular techniques)	Experimental infections only
Sufficient data to calculate prevalence with 95% confidence intervals	Conference abstracts, letters, or non-peer-reviewed grey literature
Peer-reviewed publication with full text available in English	Duplicate data from the same study population
Sufficient methodological information for quality assessment	Insufficient methodological information for quality assessment
Geographic information allowing assignment of the dominant climate region	Geographic or climate information not reported

Assessment of study quality and risk of bias: Study quality was appraised using the Joanna Briggs Institute (JBI) critical appraisal checklist for prevalence studies (Munn *et al.*, 2015). The nine domains were judged as yes, no, unclear, or not applicable. Two reviewers (FP and SOV) independently assessed potentially eligible full texts, with disagreements resolved by consensus or by a third reviewer (HCG). The JBI domains were considered individually rather than collapsed into a single numerical quality score. A standardized Microsoft Excel form (version 16.72, Microsoft Corporation, Redmond, WA, USA) recorded authorship, publication year, country, reported data-collection period, host, denominator, prevalence, diagnostic method, *Fasciola* species, and dominant Köppen-Geiger climate class.

Analysis unit, duplicate studies, and within-study dependence: Exact duplicate reports and duplicate prevalence estimates referring to the same population, diagnostic method, and sampling period were excluded during screening. When a publication reported distinct method-specific estimates for the same population, they were retained as separate prevalence studies because they represented different diagnostic targets.

Climate and period classification: Köppen-Geiger codes denote A (tropical), B (dry), C (temperate), D (continental or cold), and E (polar). These categories are ecological

descriptors rather than measurements of contemporaneous farm-level weather. Publication eligibility covered 2002–2025, whereas period subgroups described reported data collection and may include earlier years.

Statistical analysis: A random-effects model was selected because the included prevalence studies differed substantially in geography, sampling frame, diagnostic target, and study period, making a single common underlying prevalence implausible. The prevalence was pooled after Freeman–Tukey double-arcsine transformation to stabilize the variance. All reported prevalence estimates, 95% confidence intervals (CI), and 95% prediction intervals (PI) are presented on the back-transformed 0%–100% prevalence scale. Between-record heterogeneity was evaluated using Cochran's Q test, I^2, and τ^2, while 95% PI described the expected dispersion of the true prevalence across comparable settings. Prespecified subgroup analyses considered continent, reported data-collection period (1980–2013 vs. 2014–2024 for sheep and 1996–2014 vs. 2015–2024 for goats), diagnostic method, *Fasciola* species, sample size (≤400 vs. >400 animals), and dominant Köppen-Geiger climate class. A leave-one-out sensitivity analysis was used to assess the influence of each individual prevalence record on the overall pooled estimate. Univariate random-effects meta-regression was used to explore moderators, with R^2 interpreted as an exploratory association, rather than a causal effect. Small-study effects were assessed using Egger's regression and funnel plots in the overall sheep and goat analyses, and the trim-and-fill procedure was retained as originally specified. A P-value <0.05 was used as the prespecified threshold. Analyses were performed using SPSS 31 (IBM Corp., Armonk, NY, USA) and Jamovi 2.7.38.

RESULTS

Search results and eligible studies: For sheep, 4,821 studies were identified from the five literature sources, and 129 extracted prevalence studies met the inclusion criteria for the systematic review and meta-analysis (Fig. 1A). For goats, 3,474 studies were identified, and 92 prevalence studies met the inclusion criteria (Fig. 1B).

The systematic literature search and screening process produced 92 eligible goat prevalence studies comprising 1,533,682 goats (Table 3; Fig. 2). Most studies were from Asia (52; n=1,317,141) and Africa (32; n=212,533), with fewer studies from the Americas (3; n=2,932), Europe (4; n=1,021), and Oceania (1; n=55). According to the reported data-collection periods, 55 studies (n=1,501,118) covered 1996–2014, and 37 (n=32,564) covered 2015–2024.

For goats, fecal examination was represented by 45 prevalence studies (n=38,657), post-mortem inspection by 39 (n=1,487,812), and ELISA by 8 (n=7,213). Fifteen studies identified *F. hepatica* (n=22,534), 9 *F. gigantica* (n=62,166), and 68 reported *Fasciola* spp. without species-level identification (n=1,448,982). Forty-five studies included ≤400 animals (n=9,172) and 47 included >400 animals (n=1,524,510). Climate-class totals were temperate (39 studies; n=520,158), tropical (26; n=211,339), dry (25; n=801,641), and continental (2; n=544).

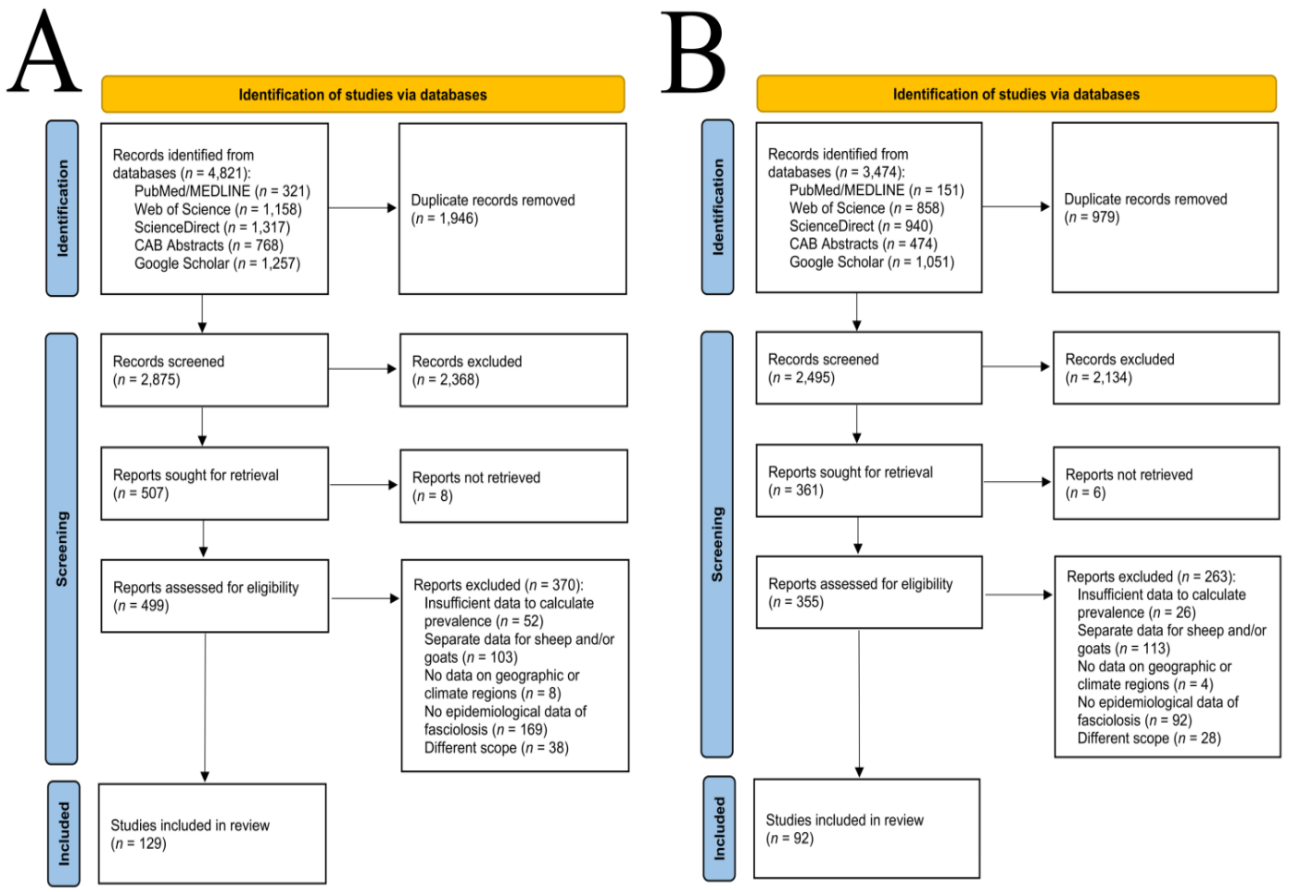


Fig. 1: PRISMA flow diagrams for sheep (A) and goats (B). The terminal values of 129 and 92 correspond to the number of extracted prevalence studies in Tables 2 and 3.

Global pooled prevalence, publication bias and sensitivity analysis: The pooled prevalence of ovine fasciolosis was 15.3% (95% CI: 11.9-19.0%; PI: 0.0-67.4%) across 129 prevalence studies and 9,249,382 sheep (Table 4). Heterogeneity was very high (I^2=99.9%, τ^2=0.315), and Cochran's Q test was significant (P<0.001; Fig. 3A), indicating substantial between-record variation. Egger's regression indicated funnel-plot asymmetry/small-study effects in the overall sheep analysis (Fig. 4A; t=3.859, P<0.001). Trim-and-fill imputed no additional studies and left the numerical estimate unchanged; this does not demonstrate the absence of bias. In leave-one-out analyses, pooled prevalence ranged from 14.78% to 15.50% for sheep and from 9.77% to 10.61% for goats. These narrow ranges indicate limited influence of any single prevalence record on the pooled point estimate but do not resolve the very high heterogeneity or small-study effects.

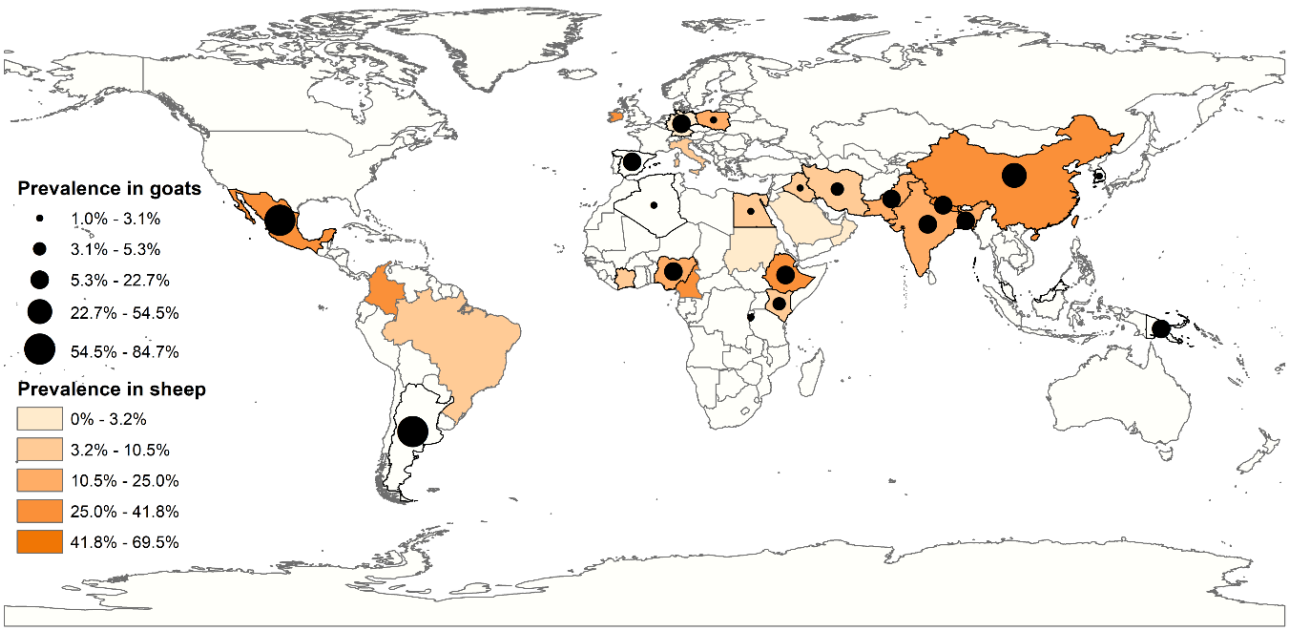


Fig. 2: Map of reported pooled prevalence patterns of ovine and caprine fasciolosis by country.

Table 2: Extracted sheep prevalence studies, diagnostic methods, and reported sampling units

Country	Study period	Diagnostic method	*Fasciola* species	Sample number and type	Prevalence (%)	Dominant climate	References
Africa							
Algeria	2008-2009	PM	*Fasciola hepatica*	5,724 livers	0	B	(Ouchene-Khelifi *et al.*, 2018)
Burundi	2020-2021	PM	*Fasciola* spp.	16 livers	0	A	(Minani *et al.*, 2023)
Cameroon	2010-2012	PM	*Fasciola* spp.	267 livers	27	A	(Takang *et al.*, 2020)
Côte d'Ivoire	2018	PM	*Fasciola* spp.	151 livers	2.7	A	(Kouadio *et al.*, 2020)
Egypt	2009	FE	*Fasciola* spp.	297 fecal	17.2	B	(Abdel-Nasser and Khalifa, 2010)
Egypt	2009-2010	FE	*Fasciola* spp.	240 fecal	10	B	(Abouzeid *et al.*, 2010)
Egypt	2010-2013	PM	*Fasciola* spp.	14,724 livers	0.41	B	(Elmonir *et al.*, 2015)
Egypt	2014-2015	FE	*Fasciola* spp.	4,920 fecal	17.87	B	(Abdel-Hakeem and Omar, 2020)
Egypt	2020-2021	PM	*Fasciola* spp.	2,338 livers	0.45	B	(Allam *et al.*, 2022)
Egypt	2021	PM	*Fasciola* spp.	16,200 livers	2.85	B	(Ahmed *et al.*, 2023)
Ethiopia	2005	FE	*Fasciola* spp.	3,697 fecal	13.2	B	(Ahmed *et al.*, 2007)
Ethiopia	2007-2008	FE	*Fasciola* spp.	395 fecal	68.1	C	(Kiros, 2016)335
Ethiopia	2009-2010	FE	*Fasciola* spp.	384 fecal	49	C	(Bitew *et al.*, 2010)
Ethiopia	2009-2010	PM	*Fasciola* spp.	500 livers	5.6	C	(Kifle and Hiko, 2011)
Ethiopia	2010-2011	PM	*Fasciola* spp.	384 livers*	20.8	C	(Yemisrach and Mekonnen, 2012)
Ethiopia	2010-2011	FE	*Fasciola* spp.	621 fecal	70.20	C	(Chanie and Begashaw, 2012)
Ethiopia	2010-2011	FE	*Fasciola* spp.	390 fecal	50.8	C	(Asrede and Shifaw, 2015)
Ethiopia	2010-2011	FE	*Fasciola* spp.	384 fecal	28.39	C	(Berhanu *et al.*, 2016)
Ethiopia	2011-2012	FE	*Fasciola* spp.	384 fecal	91.41	B	(Kelemework *et al.*, 2016)
Ethiopia	2012	FE	*Fasciola* spp.	1,528 fecal	62.7	C	(Zeleke *et al.*, 2013)
Ethiopia	2012	FE	*Fasciola* spp.	384 fecal	35.68	C	(Melkamu and Asrat, 2015)
Ethiopia	2013	PM	*Fasciola* spp.	384 livers	45.05	C	(Tsegaye and Gebeyehu, 2015)
Ethiopia	2013	FE	*Fasciola* spp.	91 fecal	48.4	C	(Taye and Jagema, 2016)
Ethiopia	2013-2014	PM	*Fasciola* spp.	205 livers	25.9	C	(Birhanu *et al.*, 2015)
Ethiopia	2013-2014	FE	*Fasciola* spp.	248 fecal	15.32	C	(Shime and Derso, 2016)
Ethiopia	2013-2014	FE	*Fasciola* spp.	280 fecal	60.7	C	(Ayele *et al.*, 2018)
Ethiopia	2014-2015	FE	*Fasciola* spp.	129 fecal	25.6	B	(Bedada *et al.*, 2017)
Ethiopia	2014-2015	FE	*Fasciola* spp.	218 fecal	33.9	B	(Dina and Henok, 2018)
Ethiopia	2015-2016	FE	*Fasciola* spp.	384 fecal	36.7	C	(Misgia *et al.*, 2016)
Ethiopia	2015-2016	FE	*Fasciola* spp.	384 fecal	50.8	C	(Hussien *et al.*, 2017)
Ethiopia	2015-2016	PM	*Fasciola* spp.	396 livers	30.3	C	(Metages *et al.*, 2018)
Ethiopia	2015-2016	FE	*Fasciola* spp.	384 fecal	32.6	C	(Gugero and Abisso, 2019)
Ethiopia	2016	PM	*Fasciola* spp.	202 livers	37.12	C	(Kassye *et al.*, 2017)

Ethiopia	2016-2017	PM	*Fasciola* spp.	384 livers	18.8	C	(Berhe *et al*., 2017)
Ethiopia	2017-2018	FE	*Fasciola* spp.	384 fecal	39.3	C	(Alemu and Chala, 2019)
Ethiopia	2017-2018	FE	*Fasciola* spp.	390 fecal	45.4	C	(Bimirew and Cherinnat, 2020)
Ethiopia	2017-2018	FE	*Fasciola* spp.	384 fecal	22.1	C	(Nuqus *et al*., 2022)
Ethiopia	2018-2019	FE	*Fasciola* spp.	392 fecal	33.9	C	(Wondmnew, 2019)
Ethiopia	2018-2021	FE	*Fasciola* spp.	1,928 fecal	18.2	C	(Molla *et al*., 2023)
Ethiopia	2019-2020	PM	*Fasciola* spp.	424 livers	20.7	C	(Oljira *et al*., 2022)
Ethiopia	2020	Coproantigen ELISA	*Fasciola hepatica*	141 fecal	9.2	C	(Abaya *et al*., 2023)
Ethiopia	2021-2022	FE	*Fasciola* spp.	220 fecal	24.5	C	(Megersa *et al*., 2024)
Kenya	1989-2004	PM	*Fasciola gigantica*	6,036 livers	5.24	A	(Mungube *et al*., 2006)
Kenya	2011-2015	PM	*Fasciola* spp.	52,573 livers	6.08	C	(Musotsi *et al*., 2017)
Nigeria	2004-2009	PM	*Fasciola* spp.	15,113 livers	0.49	B	(Mbaya *et al*., 2010)
Nigeria	2009-2018	PM	*Fasciola* spp.	64,125 livers	0.28	A	(Ola-Fadunsin *et al*., 2020)
Nigeria	2015-2016	PM	*Fasciola* spp.	300 livers	19.3	B	(Liba *et al*., 2017)
Nigeria	2016	FE	*Fasciola* spp.	95 fecal	71.6	B	(Usman *et al*., 2016)
Nigeria	2017-2018	FE	*Fasciola* spp.	880 fecal	39.1	A	(Isah, 2019)
Nigeria	2018	FE	*Fasciola* spp.	76 fecal	12.5	A	(Eke *et al*., 2019)
Nigeria	2018-2021	FE	*Fasciola* spp.	335 fecal	2.38	A	(Inegbenosun *et al*., 2023)
Nigeria	2024	FE	*Fasciola* spp.	129 fecal	3.10	A	(Ahmad *et al*., 2025)
Sudan	2009-2012	PM	*Fasciola* spp.	185,984 livers	0.19	B	(Mohamed, 2013)
Asia							
Bangladesh	2014	FE	*Fasciola gigantica*	200 fecal	46.67	A	(Hossain *et al*., 2016)
Bangladesh	2016	FE	*Fasciola gigantica*	106 fecal	11.3	C	(Poddar *et al*., 2017)
Bangladesh	2017-2018	FE	*Fasciola* spp.	549 fecal	39.0	A	(Dey *et al*., 2022)
Bangladesh	2019	FE	*Fasciola* spp.	220 fecal	13.18	A	(Bhowmik *et al*., 2020)
China	1999-2003	PM	*Fasciola hepatica*	326 livers	28.5	D	(Wang *et al*., 2006)
China	2012-2017	ELISA	*Fasciola* spp.	1,092 serum	26.4	E	(Gao *et al*., 2020)
India	2001-2004	FE	*Fasciola gigantica*	9,563 fecal	2.78	C	(Garg *et al*., 2009)
India	2004-2018	FE	*Fasciola gigantica*	89,112 fecal	0.03	B	(Swarnkar *et al*., 2019)
India	2011-2012	FE	*Fasciola* spp.	445 fecal	90.11	A	(Bansal *et al*., 2015)
India	2015-2017	FE	*Fasciola* spp.	620 fecal	1.13	A	(Ananda and Pradeep, 2021)
India	2019	FE	*Fasciola* spp.	394 fecal	5.59	A	(Malathi *et al*., 2021)
Iran	1999-2008	PM	*Fasciola* spp.	2,490,742 livers	0.93	B	(Ahmadi and Meshkehkar, 2010)
Iran	2005-2008	PM	*Fasciola* spp.	457,793 livers	2.01	B	(Khanjari *et al*., 2010)
Iran	2007-2009	PM	*Fasciola* spp.	7,726 livers	7.6	B	(Ali *et al*., 2011)
Iran	2007-2010	PM	*Fasciola* spp.	292,797 livers*	1.12	C	(Sayadi *et al*., 2015)
Iran	2008-2009	PM	*Fasciola* spp.	23,047 livers	0.35	B	(Oryan *et al*., 2011)
Iran	2008-2013	PM	*Fasciola* spp.	393,585 livers	1.4	C	(Shahbazi *et al*., 2016)
Iran	2009-2015	PM	*Fasciola* spp.	867,015 livers	1.93	B	(Mokhber-Dezfouli and Sadeghian-Chaleshtori, 2016)
Iran	2010-2011	PM	*Fasciola* spp.	1,215 livers	7.7	C	(Khanjari *et al*., 2014)
Iran	2010-2013	PM	*Fasciola* spp.	265,692 livers	7.1	C	(Ezatpour *et al*., 2015)
Iran	2011-2015	PM	*Fasciola* spp.	44,191 livers	5.22	B	(Kordshooli *et al*., 2017)
Iran	2012-2013	PM	*Fasciola* spp.	88,939 livers	3.28	B	(Khoramian *et al*., 2014)
Iran	2013	FE	*Fasciola* spp.	242 fecal	26.03	C	(Abdolali, 2016)
Iran	2013-2017	PM	*Fasciola* spp.	29,809 livers	0.24	C	(Karimi-Dehkordi and Mohammadi, 2020)
Iran	2014-2016	PM	*Fasciola* spp.	125,313 livers	1.1	C	(Bozorgomid *et al*., 2018)
Iran	2015	PM	*Fasciola hepatica*	29,247 livers	1.90	B	(Kohi *et al*., 2017)
Iran	2015-2018	Pm	*Fasciola* spp.	571,991 livers	0.62	B	(Pezeshki *et al*., 2018)
Iran	2019	PM	*Fasciola* spp.	312,811 livers	2.60	C	(Samakkhah *et al*., 2021)
Iran	2020	FE	*Fasciola* spp.	251 fecal	9.96	C	(Salehi *et al*., 2022)
Iraq	2015	ELISA	*Fasciola hepatica*	180 serum	8.9	C	(Mikaeel, 2020)
Iraq	2009-2010	PM	*Fasciola* spp.	50,518 livers	0.36	B	(Kadir *et al*., 2012)
Iran	2009-2018	PM	*Fasciola* spp.	1,339,196 livers	0.93	B	(Azizian *et al*., 2023)
Iraq	2013-2018	PM	*Fasciola* spp.	136,499 livers	0.30	B	(Al-khafaji *et al*., 2020)
Iraq	2016-2018	PM	*Fasciola* spp.	244,806 livers	0.67	B	(Al-Alo *et al*., 2019)
Iraq	2017-2018	FE	*Fasciola* spp.	523 fecal	22.46	B	(Gatie and Nejiban, 2019)
Iraq	2017-2018	PM	*Fasciola* spp.	40,488 livers	0.28	B	(Abass *et al*., 2018)
Iraq	2017-2018	PM	*Fasciola* spp.	951 livers	13.88	B	(Rasheed *et al*., 2019)
Iraq	2019	PM	*Fasciola* spp.	6,932 livers	1.76	C	(Abdullah Nerway *et al*., 2021)
Iraq	2020-2022	FE	*Fasciola* spp.	400 fecal	10	C	(Al-Lahaibi *et al*., 2023)
Iraq	2023-2024	PE	*Fasciola* spp.	361 livers	8.03	B	(Essa *et al*., 2024)
Nepal	2020	PM	*Fasciola* spp.	100 livers	34	C	(Sah *et al*., 2020)
Oman	2018-2021	PM	*Fasciola hepatica*	984 livers	0.2	B	(Ali *et al*., 2023)
Pakistan	2001-2002	PM	*Fasciola* spp.	261 livers*	23.75	B	(Sher *et al*., 2005)
Pakistan	2004-2005	FE	*Fasciola* spp.	86 fecal	4.38	C	(Asif *et al*., 2008)
Pakistan	2004-2008	FE	*Fasciola* spp.	90 fecal	4.44	C	(Gadahi *et al*., 2009)
Pakistan	2007	PM	*Fasciola* spp.	750 livers*	38	B	(Khan *et al*., 2015)
Pakistan	2007	FE	*Fasciola hepatica*	300 fecal	14.67	B	(Ijaz *et al*., 2009)
Pakistan	2010	PM	*Fasciola hepatica*	200 gall bladder	5.25	B	(Shahzad *et al*., 2012)
Pakistan	2010-2011	FE	*Fasciola hepatica*	106,711 fecal	0.9	C	(Khalid *et al*., 2015)
Pakistan	2011-2012	FE	*Fasciola* spp.	678 fecal	4.87	B	(Haleem *et al*., 2016)
Pakistan	2012	FE	*Fasciola* spp.	2,242 fecal	26.49	C	(Durrani *et al*., 2017)
Pakistan	2014	FE	*Fasciola* spp.	384 fecal	8.3	C	(Rizwan *et al*., 2017)
Pakistan	2016	ELISA	*Fasciola hepatica*	203 serum	41.87	B	(Zafar *et al*., 2019)
Pakistan	2018	ELISA	*Fasciola* spp.	1,200 serum	20.1	B	(Rizwan *et al*., 2021)

Pakistan	2021-2022	FE	*Fasciola* spp.	138 fecal	31.88	B	(Khan, 2023)
Saudi Arabia	2017-2018	PM	*Fasciola* spp.	109,253 livers	1.63	B	(Ashoor and Wakid, 2023)
Turkey	2005-2007	ELISA	*Fasciola hepatica*	213 serum	31.4	C	(Acici *et al*., 2017)
Turkey	2008	PM	*Fasciola hepatica*	1,763 livers	4.42	C	(Kara *et al*., 2009)
Turkey	2018	ELISA	*Fasciola hepatica*	320 serum	7.50	C	(Çelik and Çelik, 2018)
Turkey	2022	PM	*Fasciola* spp.	3,271 livers	26.2	B	(Ayvazoğlu *et al*., 2023)
America							
Brazil	1980-2011	PM	*Fasciola hepatica*	4,897 livers	12.25	C	(Fiss *et al*., 2013)
Brazil	2000-2005	PM	*Fasciola hepatica*	690,361 livers	8.87	C	(Cunha *et al*., 2007)
Colombia	2017-2018	FE	*Fasciola hepatica*	97 fecal	14.4	C	(Pinilla-Leon *et al*., 2019)
Colombia	2018-2019	ELISA	*Fasciola* spp.	185 serum	46.5	C	(Delgado *et al*., 2023)
Mexico	1996-1997	ELISA	*Fasciola hepatica*	381 serum	30.6	B	(Munguia-Xochihua *et al*., 2007)
Oceania							
Papua New Guinea	2011	FE	*Fasciola* spp.	110 fecal	5.5	A	(Koinari *et al*., 2013)
Europa							
Finland	2019	ELISA	*Fasciola hepatica*	1,120 serum	0	D	(Gröning *et al*., 2023)
Germany	2019-2021	FE	*Fasciola hepatica*	79 fecal farms	1.3	C	(Alstedt *et al*., 2022)
Ireland	2010-2013	FE	*Fasciola hepatica*	4,460 fecal	12.8	C	(Toolan *et al*., 2015)
Ireland	2012-2013	FE	*Fasciola hepatica*	45 farms, fecal	61.6	C	(Rinaldi *et al*., 2015)
Ireland	2014-2015	FE	*Fasciola hepatica*	305 flocks, fecal	50.4	C	(Munita *et al*., 2019)
Italy	1999-2000	FE	*Fasciola hepatica*	3,940 fecal	4.1	C	(Cringoli *et al*., 2002)
Italy	2012-2013	FE	*Fasciola hepatica*	7 farms, fecal	7.9	C	(Rinaldi *et al*., 2005)
Poland	2002-2003	FE	*Fasciola hepatica*	400 fecal	10.9	C	(Gorski *et al*., 2004)
Poland	2014-2022	ELISA	*Fasciola hepatica*	33 serum	33.3	D	(Mickiewicz *et al*., 2024)
Spain	2001	ELISA	*Fasciola hepatica*	402 serum	83.3	C	(Paz-Silva *et al*., 2003)

FE: Fecal examination under microscope; PM: Post mortem examination after slaughtering; *livers and gall bladders Köppen–Geiger codes: A, tropical; B, dry; C, temperate; D, continental or cold; E, polar.

Table 3: Extracted goat prevalence studies, diagnostic methods and reported sampling units.

Country	Study period	Diagnostic method	*Fasciola* species	Sample number and type	Prevalence (%)	Dominant climate	References
Africa							
Algeria	2008-2009	PM	*Fasciola hepatica*	5, 764 livers	2.5	C	(Ouchene-Khelifi *et al*., 2018)
Burundi	2020-2021	PM	*Fasciola* spp.	190 livers	3.16	A	(Minani *et al*., 2023)
Côte d'Ivoire	2018	PM	*Fasciola* spp.	174 livers	0	A	(Kouadio *et al*., 2020)
Egypt	2014-2015	PM	*Fasciola* spp.	790 livers	6.2	B	(Elkhtam and Khalafalla, 2016)
Egypt	2018	FE	*Fasciola* spp.	225 fecal	0.89	B	(Hassan *et al*., 2019)
Egypt	2020-2021	FE	*Fasciola* spp.	410 fecal	0.49	B	(Mohamed *et al*., 2023)
Ethiopia	2007-2008	FE	*Fasciola* spp.	105 fecal	34.3	C	(Kiros, 2016)
Ethiopia	2009-2010	PM	*Fasciola* spp.	500 livers	0.8	C	(Kifle *et al*., 2011)
Ethiopia	2010-2011	PM	*Fasciola* spp.	384 livers*	13.6	C	(Yemisrach *et al*., 2012)
Ethiopia	2011-2012	FE	*Fasciola* spp.	384 fecal	86.2	B	(Kelemework *et al*., 2016)
Ethiopia	2013-2014	PM	*Fasciola* spp.	179 livers	10.6	C	(Birhanu *et al*., 2015)
Ethiopia	2013-2014	FE	*Fasciola* spp.	136 fecal	11.8	C	(Shime *et al*., 2016)
Ethiopia	2014-2015	FE	*Fasciola* spp.	479 fecal	6.67	C	(Elemo and Geresu, 2017)
Ethiopia	2014-2015	FE	*Fasciola* spp.	166 fecal	37.9	B	(Bedada *et al*., 2017)
Ethiopia	2014-2015	FE	*Fasciola* spp.	166 fecal	29.5	B	(Dina *et al*., 2018)
Ethiopia	2015-2016	PM	*Fasciola* spp.	384 livers	14.6	C	(Metages *et al*., 2018)
Ethiopia	2016	FE	*Fasciola* spp.	343 fecal	9.7	C	(Dabasa *et al*., 2017)
Ethiopia	2016	PM	*Fasciola* spp.	194 livers	6.7	C	(Kassye *et al*., 2017)
Ethiopia	2019-2020	PM	*Fasciola* spp.	501 livers	1.6	C	(Oljira *et al*., 2022)
Ethiopia	2020	Coproantigen ELISA	*Fasciola hepatica*	50 fecal	6.0	C	(Abaya *et al*., 2023)
Ethiopia	2021-2022	FE	*Fasciola* spp.	112 fecal	10.7	C	(Megersa *et al*., 2024)
Kenya	2011-2015	PM	*Fasciola* spp.	19,263 livers	4.1	C	(Musotsi *et al*., 2017)
Kenya	2005	PM	*Fasciola gigantica*	17,743 livers	6.6	A	(Mungube *et al*., 2006)
Nigeria	2004-2009	PM	*Fasciola* spp.	9,617 livers	0.29	B	(Mbaya *et al*., 2010)
Nigeria	2009-2018	PM	*Fasciola* spp.	148,887 livers	0.23	A	(Ola-Fadunsin *et al*., 2020)
Nigeria	2011-2022	PM	*Fasciola* spp.	494 livers	11.5	A	(Okolugbo *et al*., 2023)
Nigeria	2015-2016	PM	*Fasciola* spp.	300 livers	18.3	B	(Liba *et al*., 2017)
Nigeria	2016	FE	*Fasciola* spp.	252 fecal	58.4	B	(Usman *et al*., 2016)
Nigeria	2017-2018	FE	*Fasciola* spp.	3,200 fecal	35.0	A	(Isah, 2019)
Nigeria	2018	FE	*Fasciola* spp.	92 fecal	7.25	A	(Eke *et al*., 2019)
Nigeria	2018-2021	FE	*Fasciola* spp.	920 fecal	2.36	A	(Inegbenosun *et al*., 2023)
Nigeria	2024	FE	*Fasciola* spp.	129 fecal	5.43	A	(Ahmad *et al*., 2025)
Asia							
Bangladesh	2007-2008	PM	*Fasciola gigantica*	318 livers	20.75	A	(Hossain *et al*., 2011)
Bangladesh	2007-2008	PM	*Fasciola gigantica*	325 livers	21.54	A	(Talukder *et al*., 2010)
Bangladesh	2014	FE	*Fasciola gigantica*	200 fecal	37.50	A	(Hossain *et al*., 2016)
Bangladesh	2014-2015	PM	*Fasciola gigantica*	26,443 livers	3.82	A	(Islam and Ripa, 2015)
Bangladesh	2014-2015	FE	*Fasciola* spp.	160 fecal	0	A	(Yasin *et al*., 2018)
Bangladesh	2017	FE	*Fasciola gigantica*	260 fecal	8.5	A	(Chakrabortty *et al*., 2023)
Bangladesh	2017-2018	FE	*Fasciola* spp.	1,891 fecal	39.7	A	(Dey *et al*., 2022)
Bangladesh	2018-2019	PM	*Fasciola* spp.	260 livers	35.38	A	(Shykat *et al*., 2022)
Bangladesh	2019	FE	*Fasciola* spp.	110 fecal	29.09	A	(Bhowmik *et al*., 2020)

China	2013-2014	FE	*Fasciola* spp.	200 fecal	37.0	C	(Yuan *et al*., 2016)
India	2001-2004	FE	*Fasciola gigantica*	12,741 fecal	2.35	C	(Garg *et al*., 2009)
India	2011-2012	FE	*Fasciola* spp.	960 fecal	90.00	A	(Bansal *et al*., 2015)2019
India	2011-2012	FE	*Fasciola* spp.	1,016 fecal	2.75	C	(Bihaqi *et al*., 2017)
India	2012-2015	FE	*Fasciola gigantica*	632 fecal	0.32	C	(Dixit *et al*., 2017)
India	2014-2015	FE	*Fasciola* spp.	4,320 fecal	2.33	A	(Jas *et al*., 2017)
India	2015-2017	FE	*Fasciola* spp.	500 fecal	0	A	(Ananda *et al*., 2021)
India	2017-2018	FE	*Fasciola* spp.	1,478 fecal	1.76	A	(Saiyam *et al*., 2018)
India	2019	FE	*Fasciola* spp.	236 fecal	8.89	A	(Malathi *et al*., 2021)
Iran	1999-2008	PM	*Fasciola* spp.	400,695 livers	2.79	B	(Ahmadi *et al*., 2010)
Iran	2007-2009	PM	*Fasciola* spp.	23,562 livers	5	B	(Ali *et al*., 2011)
Iran	2007-2010	PM	*Fasciola* spp.	275,185 livers*	1.10	C	(Sayadi *et al*., 2015)
Iran	2008-2013	PM	*Fasciola* spp.	81,080 livers	1.2	C	(Shahbazi *et al*., 2016)
Iran	2010-2011	PM	*Fasciola* spp.	1,215 livers	5.4	C	(Khanjari *et al*., 2014)
Iran	2010-2013	PM	*Fasciola* spp.	90,913 livers	3.9	C	(Ezatpour *et al*., 2015)
Iran	2011-2015	PM	*Fasciola* spp.	134,007 livers	2.15	B	(Kordshooli *et al*., 2017)
Iran	2012-2013	PM	*Fasciola* spp.	151,924 livers	2.76	B	(Khoramian *et al*., 2014)
Iran	2013	FE	*Fasciola* spp.	171 fecal	23.3	C	(Abdolali, 2016)
Iran	2013-2017	PM	*Fasciola* spp.	8,995 livers	0.41	C	(Karimi-Dehkordi *et al*., 2020)
Iran	2014-2016	PM	*Fasciola* spp.	11,802 livers	2.3	C	(Bozorgomid *et al*., 2018)
Iran	2015	PM	*Fasciola hepatica*	11,480 livers	2.85	B	(Kohi *et al*., 2017)
Iran	2019	PM	*Fasciola* spp.	1,125 livers	0.95	C	(Samakkhah *et al*., 2021)
Iraq	2015	ELISA	*Fasciola hepatica*	142 serum	6.3	C	(Mikaeel, 2020)
Iraq	2009-2010	PM	*Fasciola* spp.	7,662 livers	0.14	B	(Kadir *et al*., 2012)
Iraq	2013-2018	PM	*Fasciola* spp.	49,911 livers	0.26	B	(Al-khafaji *et al*., 2020)
Iraq	2017-2018	PM	*Fasciola* spp.	3,754 livers	0.63	B	(Abass *et al*., 2018)
Iraq	2019	PM	*Fasciola* spp.	804 livers	0.87	C	(Abdullah Nerway *et al*., 2021)
Korea	2009-2011	ELISA	*Fasciola hepatica*	464 serum	1.1	D	(Gebeyehu *et al*., 2013)
Malaysia	2008-2018	PM	*Fasciola* spp.	924 livers	0	A	(Kamaruddin *et al*., 2021)
Nepal	2014	FE	*Fasciola* spp.	100 fecal	47	C	(Yadav *et al*., 2015)
Nepal	2017-2018	FE	*Fasciola* spp.	150 fecal	4.67	C	(Sukupayo and Rayamajhee, 2018)
Nepal	2017-2018	FE	*Fasciola* spp.	170 fecal	2.94	C	(Sukupayo and Santosh, 2018)
Nepal	2017-2018	FE	*Fasciola* spp.	1,000 fecal	35	C	(Sah and Sah, 2019)
Nepal	2018-2019	FE	*Fasciola* spp.	400 fecal	10.25	C	(Ghimire and Bhattarai, 2019)
Pakistan	2001-2002	PM	*Fasciola* spp.	43 livers*	27.90	B	(Sher *et al*., 2005)
Pakistan	2004-2005	FE	*Fasciola* spp.	252 fecal	0	C	(Asif *et al*., 2008)
Pakistan	2004-2008	FE	*Fasciola* spp.	310 fecal	0.64	C	(Gadahi *et al*., 2009)
Pakistan	2007	FE	*Fasciola hepatica*	300 fecal	10.00	B	(Ijaz *et al*., 2008)
Pakistan	2010	PM	*Fasciola hepatica*	200 gall bladder	4.0	B	(Shahzad *et al*., 2012)
Pakistan	2012	FE	*Fasciola* spp.	2,420 fecal	9.91	C	(Durrani *et al*., 2017)
Pakistan	2013	ELISA	*Fasciola gigantica*	3,504 serum	42.69	B	(Rizwan *et al*., 2016)
Pakistan	2016	ELISA	*Fasciola hepatica*	181 serum	32.04	B	(Zafar *et al*., 2019)
Pakistan	2021-2022	FE	*Fasciola* spp.	246 fecal	30.08	B	(Khan, 2023)
America							
Argentina	2006-2011	FE	*Fasciola hepatica*	663 fecal	84.8	B	(Cuervo *et al*., 2013)
Mexico	1996-1997	ELISA	*Fasciola hepatica*	1,199 serum	43.0	B	(Munguia-Xochihua *et al*., 2007)
Mexico	2014	ELISA	*Fasciola hepatica*	1,070 serum	73.46	A	(Villa-Mancera *et al*., 2016)
Oceania							
Papua New Guinea	2011	FE	*Fasciola* spp.	55 fecal	18.2	A	(Koinari *et al*., 2013)
Europe							
Germany	2019-2021	FE	*Fasciola hepatica*	80 fecal farms	7.5	D	(Alstedt *et al*., 2022)
Poland	2002-2003	FE	*Fasciola hepatica*	180 fecal	0	C	(Gorski *et al*., 2004)
Poland	2019	FE	*Fasciola hepatica*	158 fecal	4.4	C	(Pilarczyk *et al*., 2021)
Spain	2015	ELISA	*Fasciola hepatica*	603 serum	22.7	C	(Perez-Creo *et al*., 2016)

FE: Fecal examination under microscope; PM: Post mortem examination after slaughtering; *livers and gall bladders, Köppen–Geiger codes: A, tropical; B, dry; C, temperate; D, continental or cold; E, polar.

Based on 92 prevalence studies comprising 1,533,682 goats, the pooled prevalence of caprine fasciolosis was 10.4% (95% CI: 7.2–14.1%; PI: 0.0–59.3%) under the random-effects model (Table 5). Between-record heterogeneity was very high (I^2=99.7%, τ^2=0.301), and Cochran's Q test was significant (P<0.001; Fig. 3B); therefore, the pooled estimate should be interpreted as a global summary rather than a uniform local prevalence. Egger's regression indicated funnel-plot asymmetry/small-study effects in the overall goat analysis (Fig. 4B; t=4.215, P<0.001).

Subgroup analysis by continent: Marked geographic variation was observed in sheep (Table 4). Africa had the highest pooled estimate (22.7%; 95% CI: 16.5–29.6%; 53 studies), followed by Europe (22.1%; 95% CI: 6.1–43.7%; 10 studies), the Americas (21.0%; 95% CI: 9.4–35.6%; 5 studies), Asia (8.8%; 95% CI: 5.7–12.5%; 60 studies), and Oceania (5.5%; 95% CI: 1.9–10.6%; one study). Cochran's Q test remained significant within every multi-record continental subgroup (P<0.001), confirming substantial within-continent heterogeneity. The univariate continent model accounted for 24.5% of the between-record variance (R^2=24.5%, P<0.001); however, the residual heterogeneity remained high. Estimates based on one or a few studies, particularly in Oceania and other sparsely represented strata, should be interpreted with caution.

For goats, continent was associated with prevalence in the univariate model (R^2=31.7%, P<0.001; Table 5). The Americas had the highest pooled estimate (68.2%; 95% CI:

42.3-89.1%; 3 studies; n=2,932; I^2=99.5%), followed by Oceania (18.2%; one study), Africa (10.3%; 32 studies), Asia (8.5%; 52 studies), and Europe (6.4%; four studies). Cochran's Q was significant in all multi-record continental strata (P<0.001), indicating substantial within-continent heterogeneity. The 68.2% estimate for the Americas was based on only three studies and had a wide confidence interval and high heterogeneity; therefore, it should not be interpreted as a stable continental prevalence. Estimates based on very small subgroup counts are descriptive and require extreme caution when interpreting.

For goats, continent was associated with prevalence in the univariate model (R^2=31.7%, P<0.001; Table 5). The Americas had the highest pooled estimate (68.2%; 95% CI: 42.3-89.1%; 3 studies; n=2,932; I^2=99.5%), followed by Oceania (18.2%; one study), Africa (10.3%; 32 studies), Asia (8.5%; 52 studies), and Europe (6.4%; four studies). Cochran's Q was significant in all multi-record continental strata (P<0.001), indicating substantial within-continent heterogeneity. The 68.2% estimate for the Americas was based on only three studies and had a wide confidence interval and high heterogeneity; therefore, it should not be interpreted as a stable continental prevalence. Estimates based on very small subgroup counts are descriptive and require extreme caution when interpreting.

Subgroup analysis by study period: Sheep prevalence studies with reported data-collection periods in 1980–2013 (68 studies; n=7,763,183) had a pooled prevalence of 15.2% (95% CI: 10.1–21.0%; I^2=99.9%), compared with 15.4% (95% CI: 11.3–20.1%; I^2=99.7%) for 2014–2024 (61 studies; n=1,486,199). Cochran's Q was significant in both periods (P<0.001). The study period did not explain heterogeneity in the univariate model (R^2=0%; P=0.703). These dates refer to reported data-collection periods, not publication years; the publication eligibility window remained 2002–2025.

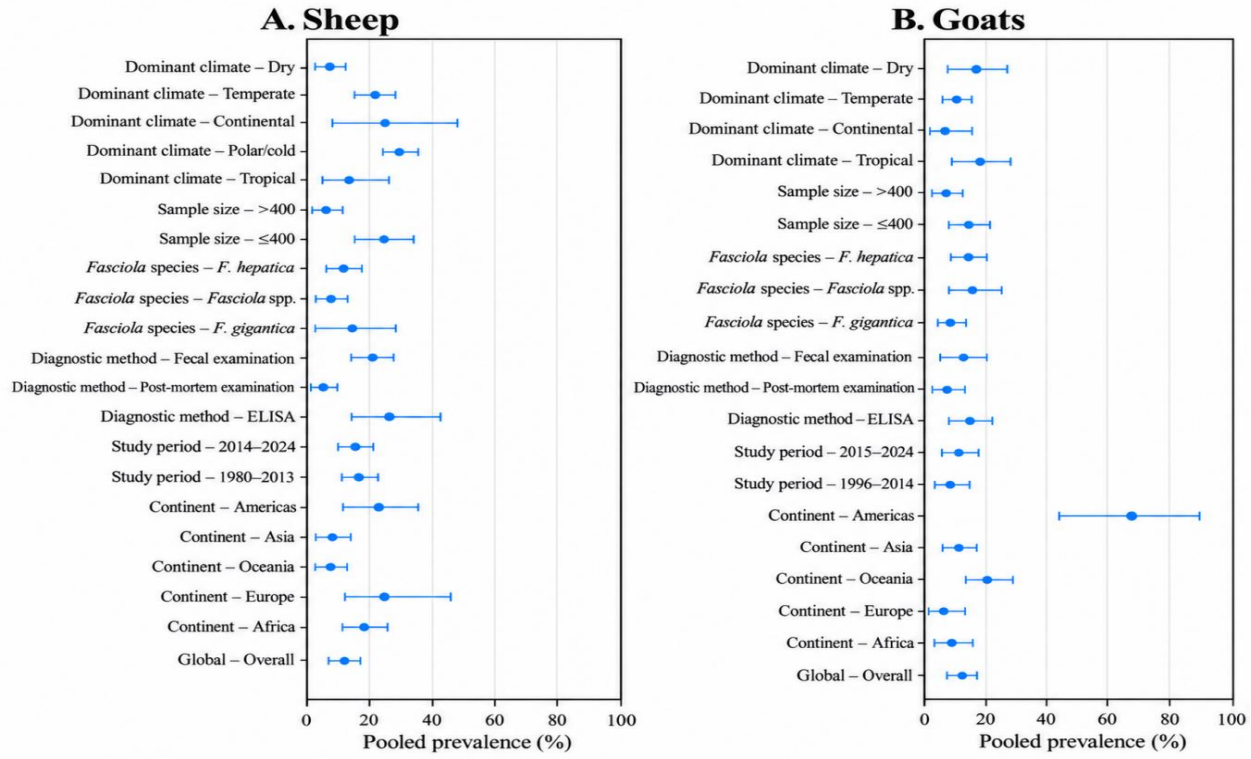


Fig. 3: Subgroup forest plots of pooled prevalence estimates of fasciolosis in sheep (A) and goats (B). Points and horizontal lines show the pooled prevalence estimates and 95% confidence intervals for the overall and subgroup analyses. The climate categories correspond to Köppen-Geiger groups A (tropical), B (dry), C (temperate), D (continental or cold), and E (polar).

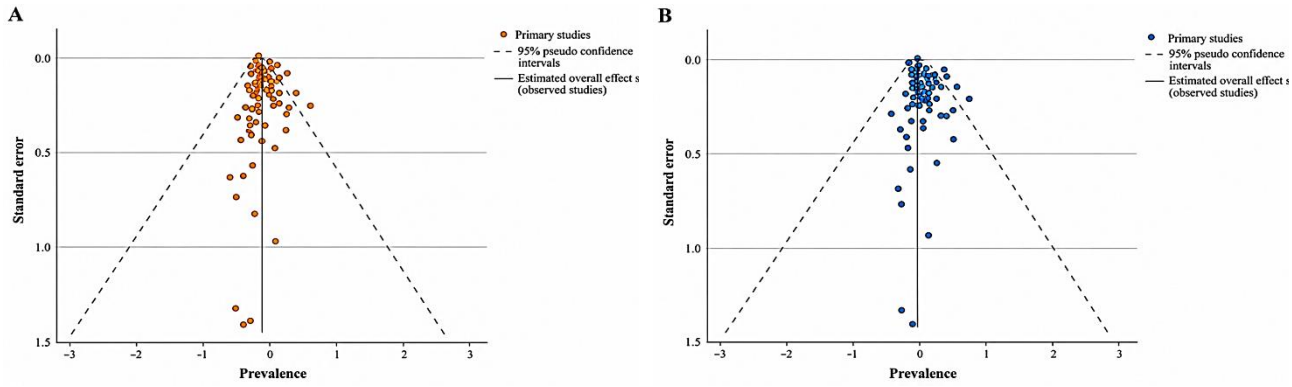


Fig. 4: Funnel plots used to assess small-study effects/publication bias in sheep (A) and goats (B).

Table 4: Overall pooled prevalence of ovine fasciolosis and subgroup meta-analysis.

Variable	Subgroup	Included studies	Sample size	Pooled prevalence (95% CI)	95% PI	Heterogeneity			Univariate meta-regression	
						I^2 (%)	τ^2	Q, P-value	R^2 (%)	P-value
Global	Overall	129	9,249,382	15.3 (11.9-19.0)	0.0-67.4	99.9	0.315	<0.001		
Continent									24.5	<0.001
	Africa	53	387,526	22.7 (16.5-29.6)	0.0-78.1	99.8	0.332	<0.001		
	Asia	60	8,155,034	8.8 (5.7-12.5)	0.0-49.1	99.9	0.221	<0.001		
	Americas	5	695,921	21.0 (9.4-35.6)	0.0-81.1	98.8	0.135	<0.001		
	Oceania	1	110	5.5 (1.9-10.6)	-	-	-	-		
	Europe	10	10,791	22.1 (6.1-43.7)	0.0-97.4	99.5	0.521	<0.001		
Study period									0	0.703
	1980-2013	68	7,763,183	15.2 (10.1-21.0)	0.0-74.3	99.9	0.398	<0.001		
	2014-2024	61	1,486,199	15.4 (11.3-20.1)	0.0-60.1	99.7	0.227	<0.001		
Diagnostic method									36.3	<0.001
	Fecal examination	62	489,416	23.6 (17.9-29.8)	0.0-77.8	99.8	0.317	<0.001		
	Post-mortem examination	55	8,754,496	6.0 (3.7-8.8)	0.0-36.8	99.9	0.158	<0.001		
	ELISA	12	5,470	25.1 (12.4-40.4)	0.0-86.6	99.4	0.327	<0.001		
Species									0	0.557
	Fasciola gigantica	5	105,017	8.7 (0.2-26.7)	0.0-90.9	99.8	0.304	<0.001		
	Fasciola spp.	97	8,291,526	16.1 (12.1-20.5)	0.0-69.1	99.9	0.322	<0.001		
	Fasciola hepatica	27	852,839	13.8 (7.3-22.0)	0.0-68.0	99.8	0.304	<0.001		
Sample size									29.4	<0.001
	≤ 400	67	16,828	24.6 (19.9-29.7)	0.0-69.7	98.1	0.213	<0.001		
	> 400	62	9,232,554	7.6 (4.4-11.7)	0.0-55.2	99.9	0.307	<0.001		
Dominant climate									10.8	0.008
	Tropical	16	74,553	14.0 (4.9-26.7)	0.0-79.0	99.7	0.403	<0.001		
	Dry	45	6,851,127	9.2 (5.0-14.2)	0.0-57.8	99.8	0.300	<0.001		
	Temperate	64	2,321,131	20.8 (15.7-26.3)	0.0-71.1	99.9	0.272	<0.001		
	Continental	3	1,479	14.4 (0.1-49.0)	0.0-100.0	99.4	0.440	<0.001		
	Polar	1	1,092	26.4 (23.8-29.0)	-	-	-	-		

Table 5: Overall pooled prevalence of caprine fasciolosis and subgroup meta-analysis.

Variable	Subgroup	Included studies	Sample size	Pooled prevalence (95% CI)	95% PI	Heterogeneity			Univariate meta-regression	
						I^2 (%)	τ^2	Q, P-value	R^2 (%)	P-value
Global	Overall	92	1,533,682	10.4 (7.2-14.1)	0.0-59.3	99.7	0.301	<0.001		
Continent									31.7	<0.001
	Africa	32	212,533	10.3 (5.6-16.3)	0.0-56.6	99.7	0.252	<0.001		
	Asia	52	1,317,141	8.5 (4.9-12.8)	0.0-53.2	99.7	0.263	<0.001		
	Americas	3	2,932	68.2 (42.3-89.1)	0.0-100.0	99.5	0.215	<0.001		
	Oceania	1	55	18.2 (9.0-29.6)	-	-	-	-		
	Europe	4	1,021	6.4 (0.3-18.7)	0.0-85.6	97.7	0.141	<0.001		
Study period									0	0.317
	1996-2014	55	1,501,118	10.3 (6.1-15.5)	0.0-63.1	99.8	0.3397	<0.001		
	2015-2024	37	32,564	10.6 (6.0-16.1)	0.0-56.8	99.5	0.253	<0.001		
Diagnostic method									54.8	<0.001
	Fecal examination	45	38,657	14.9 (9.0-21.9)	0.0-73.4	99.7	0.095	<0.001		
	Post-mortem examination	39	1,487,812	4.1 (2.4-6.2)	0.0-23.9	99.8	0.022	<0.001		
	ELISA	8	7,213	25.1 (9.4-45.1)	0.0-93.6	98.5	0.091	<0.001		
Species									3.1	0.077
	Fasciola gigantica	9	62,166	12.7 (4.6-24.2)	0.0-64.3	99.8	0.205	<0.001		
	Fasciola spp.	68	1,448,982	9.1 (5.8-13.2)	0.0-55.9	99.7	0.283	<0.001		
	Fasciola hepatica	15	22,534	15.3 (5.1-29.5)	0.0-84.0	99.7	0.452	<0.001		
Sample size									1.7	0.139
	≤ 400	45	9,172	14.4 (9.8-19.7)	0.0-59.1	98.1	0.224	<0.001		
	> 400	47	1,524,510	7.2 (3.5-12.2)	0.0-59.0	99.8	0.352	<0.001		
Dominant climate										
	Tropical	26	211,339	12.9 (5.9-22.0)	0.0-73.1	99.8	0.386	<0.001	9.4	0.012
	Dry	25	801,641	15.5 (7.0-26.3)	0.0-81.7	99.8	0.467	<0.001		
	Temperate	39	520,158	6.6 (4.0-9.7)	0.0-34.5	99.3	0.128	<0.001		
	Continental	2	544	3.3 (0.0-12.5)	-	88.5	0.056	0.003		

In goats, pooled prevalence was 10.3% (95% CI: 6.1-15.5%; 55 studies; n=1,501,118; I^2=99.8%) for the reported data-collection period 1996-2014 and 10.6% (95% CI: 6.0-16.1%; 37 studies; n=32,564; I^2=99.5%) for 2015-2024. Cochran's Q was significant in both periods (P<0.001). The univariate study-period model explained 0% of the between-record variance (R^2=0%, P=0.317), and substantial heterogeneity remained.

Subgroup analysis by diagnostic method: In sheep, the diagnostic method was associated with prevalence in the exploratory univariate moderator analysis (R^2=36.3%, P<0.001). ELISA studies revealed 25.1% (12 studies; n=5,470), fecal examination 23.6% (62 studies; n=489,416), and post-mortem inspection 6.0% (55 studies; n=8,754,496). Cochran's Q tests were significant for all three diagnostic subgroups (P<0.001). These estimates should not be ranked as if they measured one equivalent outcome: ELISA primarily reflects antibody evidence of exposure, fecal examination detects patent egg shedding, and post-mortem inspection reflects infection or lesions among slaughter-selected animals. The moderator

association is descriptive and not evidence that diagnostic method causally determines prevalence.

In goats, the diagnostic method was associated with prevalence in the exploratory univariate analysis (R^2=54.8%, P<0.001). ELISA-based studies had a pooled estimate of 25.1% (95% CI: 9.4–45.1%; 8 studies; n=7,213), fecal examination 14.9% (95% CI: 9.0–21.9%; 45 studies; n=38,657), and post-mortem inspection 4.1% (95% CI: 2.4–6.2%; 38 studies; n=1,487,812). Cochran's Q tests were significant for all three subgroups (P<0.001). The ELISA subgroup also had a wide 95% prediction interval (0.0–93.6%). Because these methods measure different biological constructs and are used in different sampling contexts, the subgroup estimates are complementary rather than directly interchangeable.

Egger's regression was emphasized for the overall host-level analyses, where funnel plot asymmetry/small study effects were detected in both sheep (t=3.859, P<0.001) and goats (t=4.215, P<0.001). Subgroup-specific Egger tests were not emphasized, particularly in sparse strata such as goat ELISA (n=8), because asymmetry tests have limited power and interpretability when few studies are available.

Subgroup analysis by *Fasciola* species: In sheep, the pooled estimates were 16.1% for *Fasciola* spp. (97 studies), 13.8% for *F. hepatica* (27 studies), and 8.7% for *F. gigantica* (five studies). Cochran's Q was significant within each species subgroup (P<0.001). *Fasciola* species did not explain a significant proportion of the heterogeneity in the univariate model (R^2=0%; P=0.557). The *F. gigantica* estimate was based on only five studies and should, therefore, be interpreted cautiously.

In goats, *Fasciola* species explained 3.1% of the between-record variance (R^2=3.1%, P=0.077), with a high residual heterogeneity. The pooled estimates were 15.3% for *F. hepatica* (15 studies), 9.1% for unspeciated *Fasciola* spp. (68 studies), and 12.7% for *F. gigantica* (9 studies). Cochran's Q was significant in all three subgroups (P<0.001). Estimates from small species-specific strata are imprecise and should not be used to infer intrinsic host susceptibility or parasite pathogenicity.

Effect of sample size and climate: In sheep, studies with ≤400 animals had a pooled prevalence of 24.6% (67 studies) compared with 7.6% in studies with >400 animals (62 studies); Cochran's Q was significant in both strata (P<0.001). The sample size category explained 29.4% of the between-record variance in the univariate analysis (R^2=29.4%, P<0.001). Dominant climate class was also associated with prevalence (R^2=10.8%, P=0.008), but several climate strata contained few studies. These findings are ecological associations and do not demonstrate that climate causes the observed prevalence differences.

For goats, the sample size category explained little between-record variance (R^2=1.7%, P=0.139). Studies with ≤400 animals had a pooled prevalence of 14.4%, whereas those with >400 animals had 7.2%; Cochran's Q was significant in both strata (P<0.001). Dominant climate class accounted for 9.4% of the between-record variance (P=0.012), but the continental subgroup contained only two studies and other climate strata were unevenly represented. These estimates require caution and should not be interpreted as direct climate-change effects; detailed climate-class estimates are presented in Table 5.

DISCUSSION

The meta-analysis estimated a worldwide pooled prevalence of 15.3% across 129 studies comprising 9,249,382 sheep. The very high heterogeneity (I^2=99.9%, τ^2=0.315) was corroborated by a significant Cochran's Q test (P<0.001), indicating that the pooled estimate summarizes diverse epidemiological settings rather than defining a universal or local risk. A recent global synthesis across humans and domestic ruminants likewise documented substantial geographic and host variation (Lan *et al.*, 2024), reinforcing the need to interpret pooled prevalence along with diagnostic methods, study settings, and uncertainties. Recent small ruminant and regional meta-analyses have also reported marked between-study heterogeneity, supporting the cautious use of pooled estimates outside the populations and settings represented (Endalamew *et al.*, 2025; Nambuya *et al.*, 2025).

Continental differences were associated with prevalence in the univariate analysis (R^2=24.5%, P<0.001); however, the estimates were supported by markedly different numbers of studies in each continent. Africa had the highest pooled estimate (22.7%; 53 studies), followed by Europe (22.1%; 10 studies) and the Americas (21.0%; 5 studies), whereas Asia had a pooled estimate of 8.8% (60 studies), and Oceania was represented by one study (5.5%). These differences may reflect a combination of snail ecology, management, diagnostic practices, and sampling methods, rather than a direct continental effect. Accordingly, wide confidence intervals and persistent residual heterogeneity limit strong geographic inference. Recent syntheses also show substantial variation within countries and regions, indicating that continents are a coarse epidemiological grouping and that local risk factors remain important sources of residual heterogeneity (Endalamew *et al.*, 2025; Nambuya *et al.*, 2025).

Diagnostic subgroup differences should be interpreted as descriptive contrasts rather than causal effects. ELISA reflects antibody evidence of exposure, fecal examination reflects patent egg shedding, and post-mortem inspection reflects infection or lesions in slaughter-selected animals. These outcomes are not epidemiologically equivalent, and seroprevalence should not be interpreted as the prevalence of pathological infection. Persistent heterogeneity within each subgroup further indicates that diagnostic category alone does not explain the observed variation (Aftab *et al.*, 2024).

The univariate association with the sample size category (R^2=29.4%, P<0.001) should be regarded as exploratory. Smaller studies may target higher-risk populations, whereas larger surveillance datasets encompass broader geographic and management diversity. Therefore, the subgroup contrast does not establish a biological effect of the sample size and should be interpreted together with the study design and the selection processes.

The broad climate class was associated with prevalence in the univariate analysis (R^2=10.8%, P=0.008), but this ecological variable did not measure farm-level temperature, rainfall, soil moisture, irrigation,

or snail abundance. This meta-analysis was not designed to estimate the effects of climate change. Evidence that temperature and moisture affect *Fasciola* and lymnaeid life cycle stages provides a biological context, but causal attribution requires temporally aligned, high-resolution climate, snail, management, and infection data (Cuervo *et al.*, 2024; Megersa *et al.*, 2024; Modabbernia *et al.*, 2024).

Temporal analysis of the reported data collection periods of 1980–2013 and 2014–2024 did not show a significant difference in pooled prevalence (R^2=0%, P=0.703). The persistence of high heterogeneity in both periods indicates that temporal grouping alone does not account for major geographic, diagnostic and management differences. No causal explanation for temporal stability can be inferred from these data.

Fasciola species did not significantly explain heterogeneity in the univariate model (R^2=0%, P=0.557). Because many reports identified only *Fasciola* spp. and the *F. gigantica* subgroup contained few studies, apparent differences among species should be interpreted cautiously and not as evidence of intrinsic differences in susceptibility or transmission efficiency.

The evaluation of small-study effects showed statistically significant funnel plot asymmetry in sheep (Egger's t=3.859, P<0.001). The trim-and-fill procedure did not impute additional studies; therefore, the pooled numerical estimate remained unchanged. However, funnel plot asymmetry can arise from heterogeneity and other study-level differences and does not by itself establish publication bias. Therefore, publication-bias diagnostics were interpreted as one component of uncertainty rather than proof of robustness.

The economic implications of the observed burden are important because fasciolosis reduces weight gain and wool production, causes liver condemnation at slaughter, and can increase mortality in heavily infected herds (Sanchez-Vazquez and Lewis, 2013; Charlier *et al.*, 2014). Recent abattoir studies have documented direct financial losses from fasciolosis through liver condemnation in endemic livestock systems, including small ruminants (Oljira *et al.*, 2022; Atanga *et al.*, 2024). The persistence of infection across regions where sheep production supports rural livelihoods and food security reinforces the need for integrated control strategies, including strategic anthelmintic treatment, pasture management, and snail habitat modification (Beesley *et al.*, 2018; Stuen and Ersdal, 2022).

The high heterogeneity across most analyses limits the direct use of global or continental estimates for local control decisions. Region-specific risk assessments should integrate local climate and hydrology, lymnaeid habitat, grazing and irrigation practices, diagnostic availability, and anthelmintic use. The moderator R^2 values quantify the associations in univariate models and should not be interpreted as proving that any single factor is the primary causal source of heterogeneity. This interpretation is consistent with recent meta-analyses, in which substantial residual heterogeneity persisted despite subgroup or meta-regression analyses, emphasizing that pooled prevalence should support rather than replace local epidemiological assessment (Endalamew *et al.*, 2025; Nambuya *et al.*, 2025).

The pooled caprine prevalence was 10.4% across 92 prevalence studies and 1,533,682 goats. Heterogeneity was very high (I^2=99.7%, τ^2=0.301), and Cochran's Q was significant (P<0.001). Egger's regression also indicated funnel plot asymmetry/small study effects (t=4.215, P<0.001). These findings reinforce the notion that the global estimate summarizes heterogeneous evidence rather than a uniform prevalence. The difference from the ovine pooled estimate should not be interpreted as proof of different host susceptibilities because the two evidence bases differ in geographic distribution, diagnostic methods, and sampling contexts. The smaller caprine evidence base and sparse representation of several regions warrant further investigations. A recent sheep-and-goat meta-analysis from Ethiopia likewise found strong host-specific differences together with very high heterogeneity, illustrating why pooled host estimates should be interpreted within their geographic, diagnostic, and management contexts (Endalamew *et al.*, 2025).

Continent was associated with prevalence in the univariate model (R^2=31.7%, P<0.001); however, the highest estimate (68.2% in the Americas) was derived from only three studies and showed high heterogeneity (I^2=99.5%; Cochran's Q, P<0.001). Therefore, this estimate is unstable and may reflect study selection, local transmission settings, and diagnostic composition rather than the representative continental prevalence. It should not be used to infer continent-wide differences in host susceptibility or transmission patterns.

Europe was represented by only four goat studies and Oceania by one; consequently, their estimates remain imprecise. Heterogeneity in Europe was still high (I^2=97.7%), whereas heterogeneity could not be estimated for Oceania from a single study. Africa and Asia contributed more studies but still showed substantial heterogeneity in the results. Across all continents, differences in production systems, diagnostic practices, water availability, and snail habitats remain plausible residual contributors that were not directly measured. Such fine-scale ecological variations are well recognized in fasciolosis transmission and can be obscured by broad geographic groupings (Vázquez *et al.*, 2023).

Most goat studies were from Asia (n=52), with a pooled prevalence of 8.5%, and high heterogeneity. The uneven geographic evidence base reinforces the need for additional studies in the Americas, Europe, and Oceania before stable continental comparisons can be made in the future. Recent regional syntheses from Africa have similarly demonstrated that prevalence can vary markedly within broad geographic areas and that risk factor distribution is spatially heterogeneous (Endalamew *et al.*, 2025; Nambuya *et al.*, 2025).

The diagnostic method was associated with prevalence in the exploratory univariate analysis, but it should not be interpreted as a causal or primary driver. ELISA reflects antibody exposure, fecal examination detects patent egg shedding, and post-mortem inspection measures infection or lesions in slaughter-selected animals. Antibody positivity can persist after infection and, therefore, cannot be equated with current pathological infection. Wide prediction intervals and substantial residual heterogeneity show that the sampling context and other unmeasured factors remain important (Aftab *et al.*, 2024).

The sample size category was not a significant univariate moderator (R^2=1.7%, P=0.139). Although smaller studies had a higher pooled estimate than larger studies, this contrast may reflect the targeted sampling and study design and should not be interpreted as a biological sample size effect.

Fasciola species were not statistically significant moderators (R^2=3.1%, P=0.077). The *F. hepatica* and *F. gigantica* subgroups contained 15 and 9 studies, respectively; consequently, differences among species estimates are too uncertain to support firm conclusions regarding pathogenicity, susceptibility, or transmission efficiency.

A broad climate class was associated with prevalence in the univariate analysis (R^2=9.4%, P=0.012), but residual heterogeneity remained high, and some climate categories contained very few studies. The classification cannot demonstrate climate-change causation because farm-level hydrology, snail abundance, irrigation, grazing behavior, and diagnostic context were not modeled jointly. Therefore, the climate findings are interpreted as broad ecological associations that require local, temporally aligned environmental data for causal assessment (Cuervo *et al.*, 2024; Megersa *et al.*, 2024; Modabbernia *et al.*, 2024).

Differences among climate classes and between sheep and goats may also reflect management and diagnostic composition, rather than climate alone. The high within-class heterogeneity in tropical and dry sittings demonstrates that broad Köppen–Geiger categories do not capture the fine-scale ecological conditions that determine lymnaeid habitat and *Fasciola* transmission. This scale mismatch is consistent with evidence that lymnaeid-associated transmission risk can vary markedly from local to global scales (Vázquez *et al.*, 2023).

No significant temporal differences were observed between the goat data collection periods of 1996–2014 and 2015–2024 (R^2=0%, P=0.317). The slightly lower I^2 in the later group (99.5% vs. 99.8%) should be interpreted descriptively because changes in geographic coverage, diagnostic composition, and study design can also affect heterogeneity.

Egger's regression indicated statistically significant funnel plot asymmetry/small-study effects in the overall goat analysis (t=4.215, P<0.001). This finding does not establish publication bias by itself because funnel plot asymmetry can also reflect heterogeneity and other study-level differences; interpretation is additionally limited by uneven regional representation and the exclusion of gray or unpublished literature.

Fasciolosis simultaneously affects livestock productivity, household livelihoods, environmental transmission foci, and human exposure. Therefore, control policies should link veterinary surveillance with monitoring of lymnaeid habitats and water sources, targeted anthelmintic use and resistance stewardship, food and water safety measures, and public health awareness in endemic communities. Harmonized diagnostic definitions and data reporting would improve comparisons across regions, while local risk assessment should determine which interventions are appropriate. Contemporary One Health frameworks emphasize the joint assessment of livestock reservoirs, lymnaeid vectors, freshwater transmission sites, environmental conditions, and human exposure, rather than treating these as separate control domains (Mas-Coma *et al.*, 2023). Recent One Health frameworks emphasize that livestock reservoirs, lymnaeid vectors, freshwater transmission sites, environmental conditions, and human exposure should be assessed jointly rather than as separate control domains (Mas-Coma *et al.* 2023). Field evidence integrating ruminant infection with snail-host surveillance illustrates the practical value of this interface-based approach (Megersa *et al.*, 2024), while recent studies from Bolivia and Egypt show how climate-sensitive vector expansion and concurrent animal-human surveillance can inform locally adapted One Health interventions (Cuervo *et al.*, 2024; Khedr *et al.*, 2025).

Limitations and interpretative considerations: Several limitations should be considered. First, heterogeneity was very high in the overall analyses and in many subgroups, limiting the transfer of global estimates to local settings. Second, some continental, climate, and species strata contained only one or a few prevalence studies, making their estimates imprecise and unstable. Third, ELISA, fecal examination, and post-mortem inspection measure different epidemiological constructs and occur in different sampling contexts; antibody exposure should not be equated with current pathological infection. Finally, climate was represented by broad ecological classes rather than contemporaneous high-resolution weather, hydrology, or snail data; climate findings are associations and should not be interpreted as causal climate-change effects.

Conclusions: The global pooled prevalence estimates indicate that fasciolosis remains an important burden in sheep and goats; however, the very high heterogeneity and wide prediction intervals mean that these summaries should not be treated as uniform local risks. Geographic, diagnostic, sample-size, species, temporal, and broad climate variables showed exploratory associations with prevalence, but these analyses did not establish causality. Diagnostic subgroups should be interpreted according to the biological target each method measures; in particular, antibody exposure is not equivalent to current pathological infection. Climate results likewise represent broad ecological associations rather than direct evidence of climate-change effects. Future surveillance should improve geographic representation, preserve transparent study-level risk-of-bias studies, account for non-independent estimates when necessary, report diagnostic context consistently, and integrate livestock, environmental, snail, food/water, and human-health information within region-specific One Health programs.

Acknowledgements: This study was supported by the Benemérita Universidad Autónoma de Puebla (VIEP-VIMA-NAT-23-I).

Author contributions: Abel Villa-Mancera: Writing – review & editing, Methodology, Conceptualization. José Manuel Robles-Robles and Alejandro Córdova-Izquierdo: Writing – original draft, Methodology, Data curation, Conceptualization. Roberto González-Garduño: Writing – review & editing, Methodology, Conceptualization. José Luis Ponce-Covarrubias: Writing – review & editing,

Supervision, Project administration, Funding acquisition. Huitziméngari Campos-García and Juan Ricardo Cruz-Aviña: Supervision, Project administration, Funding acquisition. Jaime Olivares-Pérez, Agustín Olmedo-Juárez and Nallely Rivero-Perez: Methodology, Data curation. Felipe Patricio and Samuel Ortega-Vargas: Methodology, Conceptualization. Abel Villa- Mancera: Writing – review & editing.

Funding: No financial support was provided by public, commercial, or not-for-profit funding agencies for this study.

Data Availability: All data analyzed in this study were extracted from previously published articles cited in the manuscript. The data supporting the findings of this study are provided in the article and tables. Additional extracted data are available from the corresponding author upon reasonable request.

Conflict of interest: The authors declare that there are no conflicts of interest.

Generative AI Statement: During the preparation of this manuscript, ChatGPT-5.5 was used solely to assist with the language editing and stylistic refinement. This tool was not used to generate, analyze or interpret the study data or perform statistical analyses. All scientific content, references, figures, tables, interpretations, and conclusions were critically reviewed, verified, and approved by the authors. The authors take full responsibility for the accuracy, integrity, and originality of the manuscript.

REFERENCES

Abass KS, Ibrahim EK, Khalaf RN, *et al.,* 2018. Prevalence of liver fluke infections in slaughtered animals in Kirkuk Province, Iraq. Journal of Animal Sciences and Livestock Production 2:1-5.

Abaya SW, Mereta ST, Tulu FD, *et al.,* 2023. Prevalence of Human and Animal Fasciolosis in Butajira and Gilgel Gibe Health Demographic Surveillance System Sites in Ethiopia. Tropical Medicine and Infectious Disease 8:208.

Abdel-Hakeem S and Omar M, 2020. Ovine fascioliasis: environmental epidemiology and meta-analysis of the prevalence, agro-ecological and economic factors in five provinces of the Nile Delta region of Egypt. Damanhour Journal of Veterinary Sciences 3:23-31.

Abdel-Nasser A and Khalifa R, 2010. Fascioliasis prevalences among animals and human in Upper Egypt. Journal of King Saud University-Science 22:15-19.

Abdolali M, Abbas, RNS, Reza CS, *et al*., 2016. Study on Prevalence of Fascioliasis in Ruminants in Dasht Room County in Spring and Summer of 2013. Animal and Veterinary Sciences 4:15-18.

Abdullah Nerway C, Mohammed Salih Mero W and B. Mohammed A, 2021. Prevalence of Fasciola spp. Among Slaughtered Livestock in Zakho City, Duhok Governorate - Iraq. Academic Journal of Nawroz University 10:199-206.

Abouzeid NZ, Selim AM and El-Hady K, 2010. Prevalence of gastrointestinal parasites infections in sheep in the Zoo garden and Sinai district and study the efficacy of anthelmintic drugs in the treatment of these parasites. Journal of American Science 6:544-551.

Acici M, Buyuktanir O, Bolukbas CS, *et al.,* 2017. Serologic detection of antibodies against *Fasciola hepatica* in sheep in the middle Black Sea region of Turkey. Journal of Microbiology, Immunology and Infection 50:377-381.

Aftab A, Raina O, Maxton A, *et al.,* 2024. Advances in diagnostic approaches to Fasciola infection in animals and humans: An overviews. Journal of Helminthology 98:e12.

Ahmad FZ, Abdu HM and Muhammad RH, 2025. Comparative study of Fasciolosis among Cattle, Sheep, and Goats in Selected Farms in Kano. UMYU Scientifica 4:369-373.

Ahmadi NA and Meshkehkar M, 2010. Prevalence and long term trend of liver fluke infections in sheep, goats and cattle slaughtered in Khuzestan, southwestern Iran. Journal of Paramedical Sciences 1:26-31.

Ahmed E, Markvichitr K, Tumwasorn S, *et al.,* 2007. Prevalence of Fasciola spp infections of sheep in the Middle Awash River Basin, Ethiopia. Southeast Asian Journal of Tropical Medicine Public Health 38:51-57.

Ahmed NI, Ahmed AM and Abdel-Wahab MA, 2023. Hygienic, Pathological and Economic Impacts of Liver Lesions at some Slaughterhouses in Suez Canal Region, Egypt. Journal of Advanced Veterinary Research 13:1017-1021.

Al-Alo KZ, Albishtue AA and A-Dujaily AH, 2019. Retrospective survey of Liver flukes in Sheep and Cattle based on Abattoir Data in Al-Najaf province, Iraq. Acta Scientific Veterinary Sciences 1:1-7.

Al-khafaji MA, Almremdhy HAA-e, Al-Sultany HHO, *et al.,* 2020. A retrospective survey with postmortem examination of liver flukes and lung hydatidosis in livestock in Babil, Iraq. Plant Archives 20:4537-4543.

Al-Lahaibi BY, Al-Taee AF and Suleiman EG, 2023. Evaluation of Fasciola spp in cattle and sheep in Mosul city. Assiut Veterinary Medical Journal 69:27-33.

Alemu B and Chala D, 2019. Prevalence of ovine fasciolosis and its economic impacts in and around Ambo, Ethiopia. International Journal of Veterinary Science and Animal Husbandry 5:33-38.

Ali H, Alhamrashdi A, El-Neweshy M, *et al.,* 2023. An Abattoir-based Survey of Helminthic Liver Infections and Associated Pathological Lesions in Sheep in the Sultanate of Oman. Pakistan Veterinary Journal 43:194-198.

Ali TS, Zarichehr V, Reza TM, *et al.,* 2011. Prevalence of liver flukes infections in slaughtered animals in Kashan, Isfahan province, central Iran. The IIOAB Journal 2:14-18.

Allam AWH, Elbayoumi ZH and Abdelrahman HA, 2022. Prevalence of meat borne parasites in slaughtered animals in Markaz Ashmoon Abattoirs with special references to their economic losses. Journal of Current Veterinary Research 4:1-8.

Alstedt U, Voigt K, Jager MC, *et al.,* 2022. Rumen and liver fluke infections in sheep and goats in Northern and Southern Germany. Animals (Basel) 12:1-21.

Ananda K and Pradeep B, 2021. Prevalence of gastrointestinal parasites of small ruminants in and around Shivamogga and assessment of their risk factors. Journal of Entomology and Zoology Studies 9:1507-1509.

Ashoor SJ and Wakid MH, 2023. Prevalence and hepatic histopathological findings of fascioliasis in sheep slaughtered in Jeddah, Saudi Arabia. Scientific Reports 13:6609.

Asif M, Azeem S, Asif S, *et al.,* 2008. Prevalence of gastrointestinal parasites of sheep and goats in and around Rawalpindi and Islamabad, Pakistan. Journal of Veterinary and Animal Sciences 1:14-17.

Asrede T and Shifaw A, 2015. Coprological study on the prevalence of Ovine Fasciolosis in Debre Birhan Agricultural Research Center, Ethiopia. European Journal of Biological Sciences 7:103-107.

Atanga HM, Ntonifor NH and Mahamat O, 2024. Prevalence of bovine fasciolosis and direct financial losses in cattle slaughtered in Bamenda and Bafoussam abattoirs, Western Highlands, Cameroon. Veterinary Medicine and Science 10:e70002.

Ayele Y, Wondmnew F and Tarekegn Y, 2018. The prevalence of Bovine and Ovine Fasciolosis and the associated economic loss due to liver condemnation in and around Debre-Birhan, Ethiopia. SOJ Immunology 6:1-11.

Ayvazoğlu C, Kızıltepe Ş, Demir PA, *et al.,* 2023. Prevalence and economic importance of fasciolosis in slaughtered sheep in Iğdır Province of Turkey. Euroasia Journal of Mathematics, Engineering, Natural 10:87-95.

Azizian M, Oliaee RT, Karimazar MR, *et al.,* 2023. Time series model for forecasting the prevalence of some important parasitic infections in slaughtered sheep in North-Central Iran. Archives of Veterinary Science 27:1-8.

Bansal DK, Agrawal V and Haque M, 2015. A slaughter house study on prevalence of gastrointestinal helminths among small ruminants at Mhow, Indore. Journal of Parasitic Diseases 39:773-776.

Bedada H, Gizaw F, Negash W, *et al.,* 2017. Epidemiology of small ruminant fasciolosis in arid areas of Lower Awash River Basin, Afar Region, Ethiopia. Animal and Veterinary Sciences 5:102-107.

Beesley NJ, Caminade C, Charlier J, *et al.,* 2018. Fasciola and fasciolosis in ruminants in Europe: Identifying research needs. Transboundary and Emerging Diseases 65 Suppl 1:199-216.

Berhanu M, Ayalew G and Tilahun A, 2016. Prevalence and associated risk factors for Ovine Fasciolosis in selected areas of North Gondar, Ethiopia. Advances in Biological Research 10:162-166.

Berhe N, Tefera Y, Tintagu T, *et al.,* 2017. Small ruminant fasciolosis and its direct financial loss in Dessie municipal abattoir northeastern Ethiopia. Journal of Veterinary Science & Technology 8:1-5.

Bhowmik M, Hossen MA, Mamun MA, *et al.,* 2020. Prevalence of gastrointestinal parasitic infections in sheep and goats of Sandwip Island, Chattogram, Bangladesh. Van Veterinary Journal 31:152-157.

Bihaqi SJ, Allaie IM, Banday MAA, *et al.,* 2017. Prevalence of caprine GI helminths in temperate areas of Jammu & Kashmir. Journal of Parasitic Diseases 41:843-849.

Bimirew FL, Cherinnat TM 2020. Coprological examination of Ovine Fasciolosis in Horro District community based sheep breeding program, Horro Guduru Wollega Zone, Western Ethiopia. Journal of Veterinary Healthcare 2:31-38.

Birhanu A, Tesfaye R and Derso S, 2015. Prevalence and associated risk factors of Fasciola infection in small ruminants slaughtered at Addis Ababa abattoir Enterprise, Ethiopia with reference to diagnostic value of its coprological examination. African Journal of Basic Applied Sciences 7:181-186.

Bitew M, Ibrahim N and Abdela N, 2010. Study on the prevalence of ovine fasciolosis in and around Dawa-Cheffa, Kemissie. African Journal of Agricultural Research 5:2981-2985.

Bozorgomid A, Nazari N, Kia EB, *et al.,* 2018. Epidemiology of fascioliasis in Kermanshah Province, western Iran. Iranian Journal of Public Health 47:967-972.

Çelik ÖY and Çelik BA, 2018. Investigation of the prevalence of *Fasciola hepatica* in small ruminants in the Siirt region, Turkey. Iranian Journal of Parasitology 13:627-631.

Chakrabortty M, Shohana NN, Begum N, *et al.,* 2023. Diversity and prevalence of gastrointestinal parasites of Black Bengal goats in Natore, Bangladesh. Journal of Advanced Veterinary and Animal Research 10:80-87.

Chanie M and Begashaw S, 2012. Assessment of the economic impact and prevalence of Ovine Fasciolosis in Menz Lalo Midir District, Northeast Ethiopia. Veterinary World 5:261-264.

Charlier J, Vercruysse J, Morgan E, *et al.,* 2014. Recent advances in the diagnosis, impact on production and prediction of *Fasciola hepatica* in cattle. Parasitology 141:326-335.

Cringoli G, Rinaldi L, Veneziano V, *et al.,* 2002. A cross-sectional coprological survey of liver flukes in cattle and sheep from an area of the southern Italian Apennines. Veterinary Parasitology 108:137-143.

Cuervo P, Sidoti L, Fantozzi C, *et al.,* 2013. *Fasciola hepatica* infection and association with gastrointestinal parasites in Creole goats from western Argentina. Revista Brasileira de Parasitologia Veterinaria 22:53-57.

Cuervo PF, Bargues MD, Artigas P, *et al.,* 2024. Global warming induced spread of the highest human fascioliasis hyperendemic area. Parasites & Vectors 17:434.

Cunha F, Marques S and Mattos M, 2007. Prevalence of slaughter and liver condemnation due to *Fasciola hepatica* among sheep in the state of Rio Grande do Sul, Brazil 2000 and 2005. Parasitologia Latinoamericana 62:188-191.

Dabasa G, Shanko T, Zewdei W, *et al.,* 2017. Prevalence of small ruminant gastrointestinal parasites infections and associated risk factors in selected districts of Bale zone, south eastern Ethiopia. Journal of Parasitology 9:81-88.

Delgado NU, Pereira AE, Martínez RA, *et al.,* 2023. Seroprevalence and coprological prevalence of liver fluke *Fasciola hepatica* in cattle and sheep from Santander department, Colombia. Revista Brasileira de Parasitologia Veterinaria 32:e009923.

Dey AR, Begum N, Anisuzzaman, *et al.,* 2022. A large-scale epidemiological investigation on trematode infections in small ruminants in Bangladesh. Veterinary Medicine and Science 8:1219-1228.

Dina J and Henok A, 2018. Prevalence of Fasciola Infection in Small Ruminant in and Around Hirna. Austin Journal of Veterinary Science & Animal Husbandry 5:1-5.

Dixit AK, Das G and Baghel RPS, 2017. Gastrointestinal helminthosis: prevalence and associated determinants in goats of Jabalpur, India. Journal of Parasitic Diseases 41:414-416.

Durrani A, Khan M, Ashraf K, *et al.,* 2017. Molecular epidemiology of small ruminant Fasciolosis in selected regions of Azad Jamnu and Kashmir. The Journal of Animal & Plant Sciences 27:1552-1559.

Eke SS, Omalu ICJ, Ochaguba JE, *et al.,* 2019. Prevalence of gastrointestinal parasites of sheep and goats slaughtered in Minna Modern Abattoir, Niger State, Nigeria. Journal of Animal Science and Veterinary Medicine 4:65-70.

Elemo KK and Geresu MA, 2017. Prevalence and risk factors of gastro intestinal parasitesof small ruminants in Sinana and Dinsho Districts of Bale Zone, South Eastern Ethiopia. European Journal of Biological Sciences 9:1-8.

Elkhtam A and Khalafalla R, 2016. Surveillance of helminthes and molecular phylogeny of *Fasciola gigantica* infecting goats in Sadat district, Egypt. International Journal of Scientific Research in Science and Technology 2:188-192.

Elmonir W, Mousa W and Sultan K, 2015. The prevalence of some parasitic zoonoses in different slaughtered animal species at abattoir in the Mid-Delta of Egypt; with Special Reference to its Economic Implications. Alexandria Journal of Veterinary Sciences 47:97-103.

Endalamew SG, Wassie AT, Assefa AY, *et al.,* 2025. Prevalence and risk factors of sheep and goats fasciolosis in Ethiopia: A systematic review and meta-analysis. PLOS Neglected Tropical Diseases 19:e0013074.

Essa I, Azzal G and Abdulwahid A, 2024. Molecular sequencing analysis of Fasciola spp. in sheep. Advances in Animal and Veterinary Sciences 12:1846-1852.

Ezatpour B, Hasanvand A, Azami M, *et al.,* 2015. Prevalence of liver fluke infections in slaughtered animals in Lorestan, Iran. Journal of Parasitic Diseases 39:725-729.

Fiss L, de Lourdes Adrien M, Marcolongo-Pereira C, *et al.,* 2013. Subacute and acute fasciolosis in sheep in southern Brazil. Parasitology Research 112:883-887.

Gadahi J, Arshed M, Ali Q, *et al.,* 2009. Prevalence of gastrointestinal parasites of sheep and goat in and around Rawalpindi and Islamabad, Pakistan. Veterinary World 2:51-53.

Gao X, Zhang L, Tong X, *et al.,* 2020. Epidemiological survey of fasciolosis in yaks and sheep living on the Qinghai-Tibet plateau, China. Acta Tropica 201:105212.

Garg R, Yadav C, Kumar R, *et al.,* 2009. The epidemiology of fasciolosis in ruminants in different geo-climatic regions of north India. Tropical Animal Health Production 41:1695-1700.

Gatie JA and Nejiban ZS, 2019. Prevalence of gastrointestinal parasites infestation in sheep of Thi-Qar Province, Iraq. AL-Qadisiyah Journal of Veterinary Medicine Sciences 18:123-128.

Gebeyehu E, Jung B, Byun J, *et al.,* 2013. Serologic detection of antibodies against *Fasciola hepatica* in native Korean goats (Capra hircus coreanae). Veterinarni Medicina 58:609-612.

Ghimire TR and Bhattarai N, 2019. A survey of gastrointestinal parasites of goats in a goat market in Kathmandu, Nepal. Journal of Parasitic Diseases 43:686-695.

Gorski P, Niznikowski R, Strzelec E, *et al.,* 2004. Prevalence of protozoan and helminth internal parasite infections in goat and sheep flocks in Poland. Archiv Fur Tierzucht 47:43-49.

Gröning H, Oksanen A, Skrzypczak T, *et al.,* 2023. A survey for antibodies against *Fasciola hepatica* in cattle and sheep in finland indicates a low level of exposure. Acta Veterinaria Scandinavica 65:1-9.

Gugero BC and Abisso TG, 2019. Major trematode infections of sheep in lemo woreda and associated economic loss due to liver condemnation at hossana town, southern Ethiopia. International Journal of Development Research 9:25229-25235.

Haleem S, Shadab F, Niaz S, *et al.,* 2016. Prevalence of fascioliasis in cows and sheep in district Mardan (KPK), Pakistan. Journal of Entomology and Zoology Studies 4:330-334.

Hassan NMF, Farag TK, Abu El Ezz NMT, *et al.,* 2019. Prevalence assessment of gastrointestinal parasitic infections among goats in Giza Governorate, Egypt. Bulletin of the National Research Centre 43:1-7.

Hossain M, Bhuiyan MJU, Alam MS, *et al.,* 2016. Cross sectional epidemiological investigation on the prevalence of gastrointestinal parasites of small ruminants in Sullah Upazilla of Sunamgonj District, Bangladesh. The Journal of Advances in Parasitology 2:100-104.

Hossain M, Paul S, Rahman M, *et al.,* 2011. Prevalence and economic significance of caprine fascioliasis at Sylhet district of Bangladesh. Pakistan Veterinary Journal 31:113-116.

Hussien H, Kasim S, Abdo S, *et al.,* 2017. Study on Prevalence of Ovine Fasciolosis in and Around Chole Woreda, Ethiopia. International Journal of Research Studies in Biosciencies 5:1-5.

Ijaz M, Khan M, Avais M, *et al.,* 2008. Infection rate and chemotherapy of various helminths in goats in and around Lahore. Pakistan Veterinary Journal 28:167-170.

Ijaz M, Khan M, Avais M, *et al.,* 2009. Infection rate and chemotherapy of various helminthes in diarrhoeic sheep in and around Lahore. The Journal of Animal and Plant Sciences 19:13-16.

Inegbenosun CU, Isaac C, Anika FU, *et al.,* 2023. Prevalence of intestinal parasites in animal hosts and potential implications to animal and human health in Edo, Nigeria. Journal of Veterinary Science 24:e8.

Isah UM, 2019. Studies on the prevalence of fascioliasis among ruminant animals in northern Bauchi state, north-eastern Nigeria. Parasite Epidemiol Control 5:e00090.

Islam M and Ripa RN, 2015. Prevalence of fascioliasis in slaughtered goat in Bengal meat abattoir house and its economic impact on business. Journal of Chemical, Biological Physical Sciences 5:2684-2692.

Islam MT, 2021. A systematic review and meta-analysis on prevalence and epidemiological risk factors of zoonotic Fascioliasis infection among the ruminants in Bangladesh. Heliyon 7:e08479.

Jas R, Kumar D, Bhandari A, *et al.,* 2017. Seasonal alteration in prevalence and intensity of naturally occurring gastrointestinal helminth infection in goats of New Alluvial zone of West Bengal, India. Biological Rhythm Research 48:867-876.

Kadir M, Ali N and Ridha R, 2012. Prevalence of helminthes, pneumonia and hepatitis in Kirkuk slaughter house, Kirkuk, Iraq. Iraqi Journal of Veterinary Sciences 26:83-88.

Kamaruddin NC, Razali MAI, Busayo IE, *et al.,* 2021. The first report of ruminant fascioliasis in Sabah, East Malaysia. Journal of Parasitology Research 2021:1-5.

Kara M, Gicik Y, Sari B, *et al.,* 2009. A slaughterhouse study on prevalence of some helminths of cattle and sheep in Malatya Province, Turkey. Journal of Animal Veterinary Advances 8:2200-2205.

Karimi-Dehkordi M and Mohammadi F, 2020. Prevalence of parasitic infections in livestock in slaughterhouses of Kermanshah Province during 2013-2017. Infection Epidemiology and Microbiology 6:293-304.

Kassye D, Gebeyehu M and Mekonnen D, 2017. Prevalence and associated risk factors of small ruminant Fasciolosis in Haramaya district, Eastern Ethiopia. Acta Parasitologica Globalis 8:144-149.

Kelemework S, Tilahun A, Benalfew E, *et al.,* 2016. A study on prevalence of gastrointestinal helminthiasis of sheep and goats in and around Dire Dawa, Eastern Ethiopia. Journal of Parasitology Vector Biology 8:107-113.

Khademvatan S and Majidiani H, 2019. Prevalence of fasciolosis in livestock and humans: A systematic review and meta-analysis in Iran. Comparative Immunology, Microbiology and Infectious Diseases 65:116-123.

Khalid A, Samad A, Akhter F, *et al.,* 2015. Seasonal dynamics of *Fasciola hepatica* burdens in sheep: A diagnostic study from Hazara Division, Pakistan. IOSR Journal of Pharmacy 5:48-51.

Khan H, 2023. Estimation of the prevalence of nematodes infestation in sheep and goats in District Dera Ismail Khan along with the investigation of worm burden. Pure and Applied Biology 12:722-731.

Khan MK, Sajid MS, Riaz H, *et al.*, 2013. The global burden of fasciolosis in domestic animals with an outlook on the contribution of new approaches for diagnosis and control. Parasitology Research 112:3083-3099.

Khan S, Muhammad S, Khan M, *et al.,* 2015. Study on the prevalence and gross pathology of liver fluke infestation in sheep in and around Quetta District, Pakistan. Advances in Animal and Veterinary Sciences 3:151-155.

Khanjari A, Bahonar A, Fallah S, *et al.,* 2014. Prevalence of fasciolosis and dicrocoeliosis in slaughtered sheep and goats in Amol Abattoir, Mazandaran, northern Iran. Asian Pacific Journal of Tropical Disease 4:120-124.

Khanjari A, Partovi R, Abbaszadeh S, *et al.,* 2010. A retrospective survey of fasciolosis and dicrocoeliosis in slaughtered animals in Meisam abattoir, Tehran, Iran (2005-2008). Veterinary Research Forum 1:174-178.

Khedr AA, Abdel-Hakeem SS, Mahmoud WG, *et al.,* 2025. An overview of fasciolosis in human and cattle populations in New Valley, Egypt. Frontiers in Veterinary Science 12:1572946.

Khoramian H, Arbabi M, Osqoi MM, *et al.,* 2014. Prevalence of ruminants fascioliasis and their economic effects in Kashan, center of Iran. Asian Pacific Journal of Tropical Biomedicine 4:918-922.

Kifle D and Hiko A, 2011. Abattoir survey on the prevalence and monitory loss associated with Fasciolosis in sheep and goats. International Journal of Livestock Production 2:138-141.

Kiros A, 2016. Prevalence of Fasciolosis in small ruminants and associated risk factor in and around Kombolcha. The Journal of Advances in Parasitology 3:61-65.

Kohi AM, Mehdipoor Y, Ghasemi E, *et al.,* 2017. Prevalence of some liver parasites in the slaughtered livestocks in the industrial slaughterhouse of Dezful during 2015. International Journal of Advanced Biotechnology 8:2364-2370.

Koinari M, Karl S, Ryan U, *et al.,* 2013. Infection levels of gastrointestinal parasites in sheep and goats in Papua New Guinea. Journal of Helminthology 87:409-415.

Kordshooli MS, Solhjoo K, Armand B, *et al.,* 2017. A reducing trend of fasciolosis in slaughtered animals based on abattoir data in South of Iran. Veterinary World 10:418-423.

Kouadio JN, Giovanoli Evack J, Achi LY, *et al.,* 2020. Prevalence and distribution of livestock schistosomiasis and fascioliasis in Côte d'Ivoire: results from a cross-sectional survey. BMC Veterinary Research 16:1-13.

Lan Z, Yu J, Zhang X, *et al.,* 2023. Prevalence and risk factors of ovine and caprine fasciolosis in the last 20 years in China: A systematic review and meta-analysis. Animals 13:1687.

Lan Z, Zhang X-H, Xing J-L, *et al.,* 2024. Global prevalence of liver disease in human and domestic animals caused by Fasciola: A systematic review and meta-analysis. Journal of Global Health 14:04223.

Liba J, Atsanda N and Francis M, 2017. Economic loss from liver condemnation due to Fasciolosis in slaughtered ruminants in Maiduguri abattoir, Borno State, Nigeria. Journal of Advanced Veterinary and Animal Research 4:65-70.

Malathi S, Shameem U and Komali M, 2021. Prevalence of gastrointestinal helminth parasites in domestic ruminants from Srikakulam district, Andhra Pradesh, India. Journal of Parasitic Diseases 45:823-830.

Mas-Coma S, Bargues MD and Valero MA, 2005. Fascioliasis and other plant-borne trematode zoonoses. International Journal for Parasitology 35:1255-1278.

Mas-Coma S, Valero MA and Bargues MD, 2009. Fasciola, lymnaeids and human fascioliasis, with a global overview on disease transmission, epidemiology, evolutionary genetics, molecular epidemiology and control. Advances in Parasitology 69:41-146.

Mas-Coma S, Valero MA and Bargues MD, 2022. Human and animal fascioliasis: origins and worldwide evolving scenario. Clinical Microbiology Reviews 35:e00088-00019.

Mas-Coma S, Valero MA and Bargues MD, 2023. One Health for fascioliasis control in human endemic areas. Trends in Parasitology 39:650-667.

Mbaya A, Shingu P and Luka J, 2010. A retrospective study on the prevalence of Fasciola infection in sheep and goats at slaughter and associated economic losses from condemnation of infected liver in maiduguri abattoir, Nigeria. Nigerian Veterinary Journal 31:224-228.

Megersa B, Hussein B, Shemsu J, *et al.,* 2024. Trematode infection in ruminants and diversity of snail hosts across three agro-ecological zones in Ethiopia. BMC Veterinary Research 20:197.

Melkamu S and Asrat M, 2015. Study on the prevalence of Ovine Fasciolosis in Ambasel Woreda, South Wollo Zone, Amhara Regional State, Ethiopia. Journal of Animal Research 5:437-441.

Metages Y, Mathewos M, Ademasu A, *et al.,* 2018. Abatoir Survey on Prevalence and Economic Significance of Fasciolosis in Small Ruminants Slaughtered in Addis Ababa Municipal Abatoir, Ethiopia. Acta Parasitologica 9:112-120.

Mickiewicz M, Nowek Z, Czopowicz M, *et al.,* 2024. The herd-level prevalence of *Fasciola hepatica* infection in the goat population of Poland. Journal of Veterinary Research 68:373-379.

Mikaeel FB, 2020. Prevalence of *Fasciola hepatica* in goats and sheep by using ELISA in sera and milk in Duhok, Iraq. The Iraqi Journal of Veterinary Medicine 44:113-119.

Minani S, Nsengiyumva E, Bigirimana A, *et al.,* 2023. Prevalence of Fascioliasis in Slaughtered Ruminants at Muyinga Slaughterhouse, Burundi. Veterinary Sciences: Research and Reviews 9:65-73.

Misgia F, Basaznew B and Shimels T, 2016. Coporological Prevalence of Ovine Fasciolosis in and Around Debre-Tabor Town, Ethiopia. European Journal of Biological Sciences 8:60-63.

Modabbernia G, Meshgi B and Kinsley AC, 2024. Climatic variations and Fasciola: a review of impacts across the parasite life cycle. Parasitology Research 123:300.

Mohamed HI, Arafa WM and El-Dakhly KM, 2023. Prevalence and associated risk factors of gastrointestinal helminths and coccidian infections in domestic goats, *Capra hircus*, in Minya, Egypt. Beni-Suef University Journal of Basic and Applied Sciences 12:1-13.

Mohamed SS, 2013. Prevalence, health and economical impacts of liver diseases in slaughtered cattle and sheep during 2009-2012 at Alkadroo abattoir, Sudan. Journal of Applied and Industrial Sciences 1:6-11.

Mokhber-Dezfouli M and Sadeghian-Chaleshtori S, 2016. Prevalence of liver parasitic infections in sheep and cattle slaughtered in torbat-e-heidarieh abattoir, Northeast Iran. Iranian Journal of Ruminants Health Research 1:17-22.

Molla W, Moliso MM, Gizaw S, *et al.,* 2023. Ovine gastrointestinal parasite burden and the impact of strategic anthelmintic treatment in community-based breeding sites in Ethiopia. Frontiers in Veterinary Science 10:1094672.

Mungube EO, Bauni SM, Tenhagen BA, *et al.,* 2006. The prevalence and economic significance of *Fasciola gigantica* and *Stilesia hepatica* in slaughtered animals in the semi-arid coastal Kenya. Tropical Animal Health and Production 38:475-483.

Munguia-Xochihua JA, Ibarra-Velarde F, Ducoing-Watty A, *et al.,* 2007. Prevalence of *Fasciola hepatica* (ELISA and fecal analysis) in ruminants from a semi-desert area in the northwest of Mexico. Parasitology Research 101:127-130.

Munita MP, Rea R, Martinez-Ibeas AM, *et al.,* 2019. Liver fluke in Irish sheep: prevalence and associations with management practices and co-infection with rumen fluke. Parasites & Vectors 12:525.

Munn Z, Moola S, Lisy K, *et al.,* 2015. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. International Journal of Evidence-Based Healthcare 13:147-153.

Musotsi PY, Otieno CA and Njoroge SM, 2017. Prevalence of Fasciolosis in cattle, sheep, and goats slaughtered in slaughter slabs in trans-Nzoia West, Kenya. and knowledge of livestock handlers. Journal of Biology, Agriculture and Healthcare 7:34-43.

Nambuya S, Kalinda C, Vudriko P, *et al.,* 2025. Meta-analysis and systematic review of the prevalence and risk factors of animal fascioliasis in Eastern and Southern Africa between 2000 and 2023. Preventive Veterinary Medicine 239:106490.

Nuqus DT, Wako DA and Kitessa JD, 2022. Prevalence of ovine fasciolosis and its associated risk factors: The case of in and around Bedele Town, Bunno Bedele Zone, Oromia Region, Ethiopia. International Journal of Veterinary Science and Research 8:74-79.

Okolugbo BC, Emenike FO, Onah G, *et al.,* 2023. Epidemiological Investigation and public health implications of fasciolaisis in animals slaughtered in Delta State, Southern Nigeria. International Journal of Advanced Research in Biological Sciences 10:13-21.

Ola-Fadunsin SD, Uwabujo PI, Halleed IN, *et al.,* 2020. Prevalence and financial loss estimation of parasitic diseases detected in slaughtered cattle in Kwara State, North-central Nigeria. Journal of Parasitic Diseases 44:1-9.

Oljira W, Mideksa B, Mekonnen G, *et al.,* 2022. Fasciolosis in sheep and goats slaughtered at abattoirs in Central Ethiopia and associated financial losses. Food and Waterborne Parasitology 28:e00173.

Oryan A, Mansourian M, Moazeni M, *et al.,* 2011. Liver distomatosis in cattle, sheep and goats of Northeastern Iran. Global Veterinaria 6:241-246.

Ouchene-Khelifi N, Ouchene N, Dahmani H, *et al.,* 2018. Fasciolosis due to *Fasciola hepatica* in ruminants in abattoirs and its economic impact in two regions in Algeria. Tropical Biomedicine 35:181-187.

Page MJ, McKenzie JE, Bossuyt PM, *et al.,* 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. bmj 372:n71:

Paz-Silva A, Sanchez-Andrade R, Suarez JL, *et al.,* 2003. Prevalence of natural ovine fasciolosis shown by demonstrating the presence of serum circulating antigens. Parasitology Research 91:328-331.

Perez-Creo A, Diaz P, Lopez C, *et al.,* 2016. *Fasciola hepatica* in goats from north-western Spain: Risk factor analysis using a capture ELISA. Veterinary Journal 208:104-105.

Pezeshki A, Aminfar H and Aminzare M, 2018. An analysis of common foodborne parasitic zoonoses in slaughtered sheep and cattle in Tehran, Iran, during 2015-2018. Veterinary World 11:1486-1490.

Pilarczyk B, Tomza-Marciniak A, Pilarczyk R, *et al.,* 2021. A comparison of the prevalence of the parasites of the digestive tract in goats from organic and conventional farms. Animals (Basel) 11:1-14.

Pinilla-Leon JC, Uribe-Delgado N and Florez AA, 2019. Prevalence of gastrointestinal parasites in cattle and sheep in three municipalities in the Colombian Northeastern Mountain. Veterinary World 12:48-54.

Poddar P, Begum N, Alim M, *et al.,* 2017. Prevalence of gastrointestinal helminths of sheep in Sherpur, Bangladesh. Journal of Advanced Veterinary and Animal Research 4:274-280.

Rasheed MM, Ali HA and Mahmood AJ, 2019. Prevalence of Liver Flukes in Some Areas of Salahalddin Province. Tikrit Journal for Agricultural Sciences 19:29-34.

Rinaldi L, Biggeri A, Musella V, *et al.,* 2015. Sheep and *Fasciola hepatica* in Europe: the GLOWORM experience. Geospatial Health 9:309-317.

Rinaldi L, Perugini AG, Capuano F, *et al.,* 2005. Characterization of the second internal transcribed spacer of ribosomal DNA of Calicophoron daubneyi from various hosts and locations in southern Italy. Veterinary Parasitology 131:247-253.

Rizwan H, Sajid M, Abbas H, *et al.,* 2021. Epidemiology, burden and seasonal variation of fasciolosis determined through faecal examination and excretory/secretory antigens based ELISA. Journal of the Hellenic Veterinary Medical Society 72:3449-3454.

Rizwan H, Sajid M, Iqbal Z, *et al.,* 2017. Point prevalence of gastrointestinal parasites of domestic sheep (Ovis aries) in district Sialkot, Punjab, Pakistan. Journal of Animal Plant Sciences 27:803-808.

Rizwan H, Sajid M, Khan M, *et al.,* 2016. Seroepidemiology of goat fascioliasis in district Sargodha, Punjab, Pakistan based on excretory secretory antigens of the indigenous strains of *Fasciola gigantica*. Revue de Medicine Veterinaire 167:10-17.

Sah RP and Sah RB, 2019. Prevalence of fascioliasis in goat in Sunsari district, Nepal. International Journal of Veterinary Science and Animal Husbandry 1:9-15.

Sah RP, Yadav MP, Kanu SP, *et al.,* 2020. Study on ovine fascioliasis: Case study, associated risk factors and economic significance at Sheep and Goat Research Program, Guthichaur, Jumla, Nepal. International Journal of Veterinary Sciences Animal Husbandry 5:164-168.

Saiyam R, Das G, Verma R, *et al.,* 2018. Seasonal prevalence of caprine gastrointestinal helminths in central Madhya Pradesh. Journal of Entomology and Zoology Studies 6:979-982.

Salehi A, Razavi M and Vahedi Nouri N, 2022. Seasonal Prevalence of Helminthic Infections in the Gastrointestinal Tract of Sheep in Mazandaran Province, Northern Iran. Journal of Parasitology Research 2022:7392801.

Samakkhah AS, Tooryan F, Hushmandi K, *et al.,* 2021. Prevalence of Parasitic Infections in the Liver of Slaughtered Animals and Its Economic Losses in Modern Slaughterhouses of Mazandaran Province during 2018-2019; A Retrospective Study. Journal of Occupational Health Epidemiology 10:209-216.

Sanchez-Vazquez MJ and Lewis FI, 2013. Investigating the impact of fasciolosis on cattle carcase performance. Veterinary Parasitology 193:307-311.

Sayadi M, Rezaei M, Jahanbakhsh M, *et al.,* 2015. The Prevalence of Fascioliasis in Slaughtered Animals of the Industrial Slaughterhouse of Arak, Iran. Iranian Journal of Health sciences 3:59-64.

Schweizer G, Braun U, Deplazes P, *et al.,* 2005. Estimating the financial losses due to bovine fasciolosis in Switzerland. The Veterinary Record 157:188.

Shahbazi Y, Hashemnia M and Safavi EA, 2016. A retrospective survey of liver flukes in livestock based on abattoir data in Kermanshah, west of Iran. Journal of Parasitic Diseases 40:948-953.

Shahzad W, Mehmood K, Munir R, *et al.,* 2012. Prevalence and molecular diagnosis of *Fasciola hepatica* in sheep and goats in different districts of Punjab, Pakistan. Pakistan Veterinary Journal 32:535-538.

Sher A, Muhammad N, Gul R, *et al.,* 2005. Diversity and prevalence of trematodes in livers of sheep and goat in Quetta, Pakistan. Pakistan Journal of Zoology 37:205-210.

Shime A and Derso S, 2016. Prevalence of major gastrointestinal helminthes parasites of small ruminant in Enemay Woreda. Advances in Life Science and Technology 49:11-16.

Shykat CA, Islam S, Ahmed F, *et al.,* 2022. Current status of fasciolosis of goat in Sylhet, Bangladesh: An Integrated Morphomolecular Study. Journal of Parasitology Research 2022:6159388.

Stuen S and Ersdal C, 2022. Fasciolosis-An increasing challenge in the sheep industry. Animals (Basel) 12:

Sukupayo P and Rayamajhee B, 2018. Prevalence of intestinal helminth parasites in goats of Roshi rural munucipality-11, NEPAL. International Journal of Scientific Engineering Research 9:1471-1475.

Sukupayo PR and Santosh K, 2018. Prevalence of Intestinal Helminth Parasites on Goats in Salley, Panauti Municipality, Nepal. International Journal of Innovative Science and Research Technology 3:680-682.

Swarnkar CP, Khan FA and Singh D, 2019. Prevalence of fluke infestation in sheep flocks of Rajasthan, India. Biological Rhythm Research 52:645-653.

Takang EE, LeBreton M, Ayuk C, *et al.,* 2020. A socio-economic study of Fasciola infections in cattle and sheep at the Etoudi slaughterhouse, Yaoundé, Cameroon. Journal of Helminthology 94:e92.

Talukder S, Bhuiyan M, Hossain MM, *et al.,* 2010. Pathological investigation of liver fluke infection of slaughtered black Bengal goat in a selected area of Bangladesh. Bangladesh Journal of Veterinary Medicine 8:35-40.

Taye M, Jagema T 2016. Study of ruminant fasciolosis in selected districts in Upper Awash River Basin, South Western Shoa, Ethiopia. Journal of Veterinary Science & Technology 7:1-4.

Toolan DP, Mitchell G, Searle K, *et al.,* 2015. Bovine and ovine rumen fluke in Ireland-Prevalence, risk factors and species identity based on passive veterinary surveillance and abattoir findings. Veterinary Parasitology 212:168-174.

Tsegaye B and Gebeyehu B, 2015. Fasciolosis: Abattoir prevalence and severity of liver lesions in sheep slaughtered at Debre-Birhan Municipal Abattoir, North East Ethiopia. International Journal of Agricultural Science Research 4:78-81.

Usman A, Malann Y and Babeker E, 2016. Prevalence of Gastrointestinal parasitic infections among ruminants animals slaughtered in Katagum abattoir of Bauchi state, Nigeria. International Journal of Innovative Research and Advanced Studies 3:167-170.

Vázquez AA, Alba A, Alda P, *et al.*, 2023. Lymnaeid snails and the transmission of fasciolosis: understanding the differential risks from local to global scale. In: The Lymnaeidae: A Handbook on Their Natural History and Parasitological Significance (Vinarski MV and Vázquez AA, eds). Springer International Publishing, Cham, Switzerland, pp:359-394.

Villa-Mancera A, Molina-Mendoza P, Hernandez-Guzman K, *et al.,* 2016. Comparative diagnosis of serum IgG1 and coproantigen ELISA for Fasciolosis detection of goats in Mexico. BioMed Research International 2016:1-7.

Villa-Mancera A and Reynoso-Palomar A, 2019. High prevalence, potential economic impact, and risk factors of *Fasciola hepatica* in dairy herds in tropical, dry and temperate climate regions in Mexico. Acta Tropica 193:169-175.

Wang C, Qiu J, Zhu X, *et al.,* 2006. Survey of helminths in adult sheep in Heilongjiang Province, People's Republic of China. Veterinary Parasitology 140:378-382.

Wondmnew K, 2019. Study on prevalence of Ovine Fasciolosis in Kutaber Woreda, South Wollo, Amhara Region, Ethiopia. Biomedical Journal of Scientific & Technical Research 21:1-5.

Yadav S, Ahaduzzaman M, Sarker S, *et al.,* 2015. Epidemiological survey of fascioliasis in cattle, buffalo and goat in Mahottari and Dhanusha, Nepal. The Journal of Advances in Parasitology 2:51-56.

Yasin MG, Alim MA, Ahasan SA, *et al.,* 2018. Trematode infections in farm animals and their vector snails in Saint Martin's Island, the southeastern offshore area of Bangladesh in the Bay of Bengal. Journal of Veterinary Medical Science 80:684-688.

Yemisrach A and Mekonnen A, 2012. An abattoir study on the prevalence of fasciolosis in cattle, sheep and goats in Debre Zeit town, Ethiopia. Global Veterinaria 8:308-314.

Yuan W, Liu JM, Lu K, *et al.,* 2016. Molecular identification and seasonal infections of species of Fasciola in ruminants from two provinces in China. Journal of Helminthology 90:359-363.

Zafar A, Khan MK, Sindhu D, *et al.,* 2019. Seroprevalence of *Fasciola hepatica* in Small Ruminants of District Chakwal, Punjab, Pakistan. Pakistan Veterinary Journal 39:96-100.

Zeleke G, Menkir S and Desta M, 2013. Prevalence of ovine fasciolosis and its economic significance in basona worana district, central Ethiopia. Scientific Journal of Zoology 2:81-94.