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Prevalence's and Associated Risk Factors of Mange Mite Infestation in Small Ruminants in and around Toke Kutaye District, Ethiopia

Assaye Desta Amare

asayedesta3@gmail.com

Bahirdar university

Misgane Fekede

Woldia univerdity

Animaw Andargie Worku

Woldia univerdity

Getachew Tadesse Seyum

Woldia univerdity

Ashenafi Wondye Dagne

Woldia univerdity

Teketay Bayleyegn Derso

Woldia univerdity

Asmamaw Bihonegn

Woldia univerdity

Yihenew Getahun Ambaw

Woldia univerdity

Asaye Wolelie Fentie

Woldia univerdity

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Abstract

Background: Mange mite infestation is one of the skin diseases of small ruminants that can cause huge economic loss through a decrease in production and downgrading quality of skin.

Study method: A cross-sectional study was designed between December, 2023 and October 2024 to determine the prevalence of mange mite infestation and associated risk factors in small ruminants in Toke kutaye district, West Shewa, Ethiopia.

Result: Overall prevalence of mange mite infestation in this study was found 31.25 %. Sheep were found highly prevalent for mange mite infestation (39.2%) compared to ovine species (22.7%) and the difference was found statistically significant (P=0.00, OR=4.39, CI=2.56-7.53). Male sheep and goats were found highly prevalent (49.75%) compared to female (19.79%) which was found statistically significant (p=0.00, OR=4.79, CI 3.02-7.6). With regard to body condition; animal with poor body condition had found significantly higher prevalence 60 (59.4%) compared to medium 30(23.07%) and 30(19.6%) body condition animals (P=0.00, OR=4.8, CI=2.79-8.33) compared to animals with medium and good body condition. Sarcoptes Caprae was found significantly higher prevalence (3.12%) (p=0.00, OR=4.76, CI=2.56-8.88) compared to Sarcoptes ovis (6.78%), Demodex Caprae (6.78%), Psoroptes ovis (3.6%). Higher prevalence was detected in animals under extensive management systems (40.6%) compared to (21.87%) (P=0.001, OR=2.47, CI=1.58-3.87). Higher prevalence was observe 31(16.15%) in dry season compared to wet season 76(39.9%) (p=0.0001, OR=7.78, CI=4.48- 13.48).

Conclusion: The study concluded that mange mite infestation was highly prevalent and represents one of the major parasitic health problems affecting small ruminants in the study area.

1. INTRODUCTION

Ethiopia has Africa's largest livestock population, including approximately 65 million cattle, 40 million sheep, 51 million goats, 8 million camels, and 49 million chickens [1]. Small ruminants are vital to the farming system, accounting for 12% of consumed livestock products and 48% of cash income at the farm level [1].

Skins and hides are the country's second-largest source of foreign exchange [3]. Ethiopia produces 16.2 million skins annually, with off-take rates of 33% for sheep and 32.5% for goats [3]. Optimizing these off-take rates could allow Ethiopia to export about 700,000 sheep and 2 million goats annually, while supplying 1,078,000 sheep and 1,128,000 goats to the domestic market.

In Ethiopia, approximately 56% of goat skins and 35% of sheep skins are rejected or downgraded, largely due to illnesses, poor management, and inadequate nutrition [4, 5, 6]. Ectoparasites, particularly mange mites, are a major contributor to this financial loss by reducing skin value and posing a significant risk to the export market [4,5,6]. Mange commonly causes discomfort, scratching, allergic dermatitis, irritation,

exudation, crusts, and scabs. If untreated, these mites lead to a severe deterioration in both skin quality and the animal's overall bodily condition [7].

In Ethiopia, available studies indicate that mange mites in small ruminants primarily belong to three main genera: *Sarcoptes*, *Psoroptes*, and *Demodex* [10, 11]. Sarcoptic mange (*Sarcoptes scabiei*), caused by burrowing mites, results in extreme pruritus (itching) that leads to constant scratching, restlessness, reduced feeding time, and degraded skin quality. Psoroptic mange (*Psoroptes cuniculi*) involves superficial, non-burrowing mites feeding on skin lipids, with hypersensitivity reactions (extreme itching, wool loss, restlessness, self-mutilation, weight loss, and potential death) caused by mite fecal matter [12]. In contrast, demodectic mange (*Demodex caprae*) mites live deep within the skin, causing pustules, redness, and scaling, nodules, and hair loss [12]. Both infestations are diagnosed via skin scraping: a mineral oil-dipped blade is used to scrape superficially for psoroptic mites or deeply (until capillary fluid appears) for demodectic mites [13].

Even though mange mite infestation is assumed to be a widespread emergency in Ethiopia with several studies regarding prevalence's of mange mites in different parts of the country [14, 15, 16, 17, 18, 19], Knowledge and public awareness on mange mite infestation and associated risk factors remains limited in toke kutaye district. Accordingly, this study was designed to describe the prevalence of mange among small ruminants in this district and identify potential risk factors.

2. MATERIALS AND METHODS

2.1. Description of the Study Area

Toke kutaye district (figure. 1) is located in the West Shewa Zone of Oromia Regional State at distance of 131 km away from Addis Ababa. The study area is located at approximately 8°58'N 37°46'E/ 8.967°N 37.767°E in terms of latitude and longitude, respectively. The area experiences an average rainfall of 900mm (900-1000mm) and has an annual average temperature of 22.5°C, ranging from 16°C to 29°C. It has a bi-modal rainfall distribution with a short rain season from February to May and a long rain season from June to September. The elevation of the area is 2101 meters above sea level According to [20].

2.2. Study Design

A cross sectional study was conducted to determine the prevalence of mange mite's infestation in sheep and goats. The prevalence of mange mites, association of host related risk factors with the presence of mite infestation were investigated. The surveyed animals were small ruminants (sheep and goats) randomly selected according to age, sex herd size and body condition. Origin, management practice and seasonal variation were considered as environmental risk factors.

2.3. Sampling strategy and Study Population

Toke kutaye district was selected purposively. A stage sampling technique was employed to select representative households. Permission for sample collection was obtained verbally from the owners of the household-owned sheep and goat flocks before collecting the samples. The owners were informed about the purpose of the study, and their consent was obtained prior to sample collection. The study was conducted on local breeds of both sheep and goat in toke-kutaye district. Study animals were selected by simple random technique. Four kebeles namely; Nega File, Melka Nega Dembi, Birbirsa Dogoma and Emela Dawe Ajo were selected by simple random sampling technique from toke-kutaye district. Lastly, the total number of households with sheep and goats flock in the selected kebeles was acquired from the agricultural office. Study animals were selected from flock by simple random technique.

2.4. Sample Size Determination

The sample size were calculated using the formula given by [23] by taking an expected prevalence of 50% and the study considered 95% of confidence interval with 5% absolute precision.

$$n = \frac{(1.96)^2 \, x P_{exp}(1-P_{exp})}{d^2}$$

Where, n=sample size;

P_{exp} = expected prevalence = 50% and

d = desired absolute precision = 5%

Accordingly, the total sample size was determined to be 384 animals. Based on this 199 sheep and 185 goats were included in this study.

2.5. Sample collection and Processing

During sample collection, information on the sex, origin, herd size, species of mange mite, species of animals, body condition, Season variation, and age and management system was recorded. Age was classified as young, adult and old. The age of sheep and goats was classified into young (0 to 1 year), adult (2 to 4 years), and old (above 4 years old animal) as per the recommendation given by [24]. Whereas the scoring of the body condition of the sheep and goats was determined according to [25] with a scale of 1.0 to 5.0. Thus, sheep and goats with a score of 1 and 2 were categorized as poor, 3 as a medium, and 4 and 5 as good. Based on this; examinations of each animal were conducted by visual inspection and palpation of skin lesions and by the eventual identification of ectoparasites. When skin lesions were evidenced skins scrapping from suspected cases of mange were collected. Season was classified as wet and dry season. Wet season has included June, July, august and September; whereas, dry season has included January, February, march and April.

2.6. Laboratory Procedures

The skin scraping sample was collected in to sampling bottles from positively suspected animals and transported to Ambo University, Laboratory of parasitology for further processing and identification of parasite. Skin scrap was placed on a microscopic slide, mixed with few drops of 10–30% KOH to dissolve tissue material, then gently wormed and left for few minutes then a cover is placed, pressed and the slide was examined and identified under light microscope according to protocol in [26].

2.7. Data Analysis

All the raw data obtained were entered into a Microsoft Excel spreadsheet. The collected data were analyzed using the STATA version 14.0 software program. Descriptive statistics were used to summarize the prevalence of mange mite species identified. Odds ratio was used to measure strength of association between outcome variable and independent variables. A p-value of < 0.05 was considered significant.

2.8. Ethical consideration

An ethical approval was received from Animal Research Ethics and Review Commite of Woldia University and all activities were in line with the relevant guidelines and regulations of this institution.

3. RESULTS

A total of 384 small ruminants (196 goats and 188 sheep) were investigated for mite infestation, with an overall prevalence of 24 (6.25%). *Sarcoptes*, *Demodex*, and mixed infestations (*sarcoptes* and *Demodex*) were identified.

A total of 384 small ruminants (196 goats and 188 sheep) were investigated for mite infestation, with an overall prevalence of 120(31.25%). According to Table 1, the prevalence of sarcoptic mite infestation was reported in both sheep and goats but was higher in sheep (39.2) than in goats (22.7%). Male sheep and goats were highly infested with sarcoptic mites (43.75%), whereas female sheep and goats were infested with demodectic mites (19.79%). Age-related comparison of the current findings indicated that old sheep and goats were highly infested with sarcoptic mites (39%), followed by adult (30%), and young (10%).

The result obtained from this study showed that out of the 384 examined small ruminant 120 (31.25%) were found infested with four species of mange mites (table. 1) namely; *Sarcoptese scabei var Caprae* (11.46%) followed by *Demodex Caprae* (6.78%), *Sarcoptese scabei var ovis* (6.78%) and *Psoroptes ovis* (3.6%) (table.2) below.

Table 1
Prevalence's of small ruminant mange mites with associated risk factors during study period.

Risk factors		Number examined	Number of positive animals (%)	OR	CI	p-value
Species of animals	Goat	185	42 (22.7%)	Ref.	2.56 -7.53	P = 0.00
	Sheep	199	78 (39.2%)	4.39		
Age	Young	29	3 (10%)	Ref.	Ref.	Ref.
	Adult	245	74 (30%)	2.3	0.65–8.16	P = 0.19
	Old	110	43 (39%)	3.4	0.94 -12.45	P = 0.06
Sex	Female	220	38 (19.79%)	Ref	Ref.	P = 0.0001
	Male	164	84 (43.75%)	4.7895	3.02–7.6	
Body condition score	Good	153	30(19.6%)	Ref.	Ref.	Ref
	Medium	130	30(23.07%)	2.4118	1.32–4.4	P = 0.94
	Poor	101	60(59.4%)	4.8235	2.79–8.33	P = 0.00
Origin	NF	96	21(22%)	Ref.	Ref.	Ref.
	BD	96	30(31.25%)	1.62	0.85 -3.10	P = 0.14
	MND	96	33(34.37%)	1.87	0.98 -3.55	P = 0.05
	EDA	96	26(27.08%)	1.22	0.63 -2.36	P = 0.55
Management system	Extensive	192	78(40.6%)	2.47	1.58–3.87	P = 0.001
	Semi intensive	192	42(21.875%)	Ref	Ref.	
Flock size	Small	128	21(16.4%)	Ref.	Ref.	Ref
	Medium	128	30(23.44%)	1.66	0.89 -3.09	P = 0.11
	Large	128	56(43.75%)	3.9630	2.21 -7.10	P = 0.00

NF = Nega File MND = Melka Nega Dembi

BD = Birbirsa Dogoma EDA = Emela Dawe Ajo

Risk factors		Number examined	Number of positive animals (%)	OR	CI	p-value
Season	Wet	192	76(39.9%)	7.78	4.48 13.48	P = 0.0001
	Dry	192	31(16.15%)	Ref.	Ref.	
Over all		**384**	**120(31.25%)**			
NF = Nega File MND = Melka Nega Dembi						
BD = Birbirsa Dogoma EDA = Emela Dawe Ajo						

Table 2
 Prevalence's of mange mites identified and their prevalence during study period.

Species of mange mites	Number examined	Number positive	Prevalence	OR	CI	P-value
S. *Caprae*	384	44	11.46 %	4.76	2.56–8.88	P = 0.0001
S. *Ovis*	384	26	6.78 %	2.66	1.36–5.19	P = 0.0041
D. *Caprae*	384	26	6.78%	2.66	1.36–5.19	P = 0.0041
P. *Ovis*	384	14	3.6%	Ref.	Ref.	Ref.
Total	**384**		**120(31.25) %**			

4. DISCUSSION

The overall prevalence of mange mite infestation in small ruminants in the study area was 31.25%. This finding is lower than the prevalence of 59.6% reported in the Amhara Regional State [14]. However, it is higher than the prevalence rates of 6.25% reported from Wolaita-Sodo [19] and 4.66% reported from Jigjiga [17]. The variation among these findings may be attributed to differences in agro-ecological conditions, environmental factors, management practices and the level of parasite control programs or interventions implemented in the respective areas.

With regard to the species of small ruminants, sheep showed a higher prevalence of mange mite infestation (39.2%) compared with goats (22.7%). The difference was statistically significant (P = 0.00, OR = 4.39, CI = 2.56–7.53). Similar findings were reported in a study conducted in Haramaya Woreda by Habib and Wubit (2017) [16], and the result is also consistent with reports from the eastern Amhara region by Kebeb et al. (2014) [15].

Male sheep and goats showed a higher prevalence of mange mite infestation (49.75%) compared with females (19.79%), and this difference was statistically significant (P = 0.00, OR = 4.79, CI = 3.02–7.6). This finding is consistent with a study conducted in Wag-Himra, where the prevalence was higher in males (32%) than in females (25.5%) [18]. However, it differs from a study carried out in the Wolaita Zone, which reported prevalence rates of 6% in males and 6.53% in females [27]. The observed variation may be attributed to the frequent contact of male animals with females during the mating period.

Regarding age groups, the prevalence of mange mite infestation was higher in older sheep and goats (39%) compared with adults (30%) and young animals (10%). However, the observed difference was not statistically significant (P = 0.06, OR = 3.42, CI = 0.94–12.45). This finding differs from the report of [19], who observed the highest prevalence in adult animals (8.33%) compared with both old and young groups. Similarly, a study conducted in Jigjiga reported a higher prevalence in adults (5.5%) than in young animals (3.25%) [17]. The relatively higher prevalence observed in older animals in the present study may be associated with reduced immune competence and poorer nutritional status that often occur with aging. Although young animals may also be susceptible, older animals tend to be more vulnerable to chronic, severe, and persistent infestations.

With regard to body condition, animals with poor body condition showed a significantly higher prevalence of mange mite infestation 60 (59.4%) compared with animals having medium 30 (23.07%) and good 10 (19.6%) body condition (P = 0.00, OR = 4.8, CI = 2.79–8.33). This result is consistent with findings reported in Jigjiga [17], northeastern Ethiopia [28], and East Hararghe Zone [16]. Poor body condition is often associated with malnutrition, which weakens the immune system and increases susceptibility to diseases, including mange mite infestation [11].

Regarding the species of mange mites, *Sarcoptes caprae* showed a significantly higher prevalence (P = 0.00, OR = 4.76, CI = 2.56–8.88) compared with *Sarcoptes ovis*, *Demodex caprae*, and *Psoroptes ovis*. In another study conducted in Haramaya, the most prevalent mite species was *Sarcoptes scabiei* (7.44%), followed by *Psoroptes ovis* (1.65%) and *Demodex caprae* (1.24%) [16]. similarly, a study in South Wollo reported the overall prevalence of *Sarcoptes*, *Demodex*, and *Psoroptes* as 4.17%, 1.56%, and 0.52%, respectively [29]. Consistent with previous studies, sarcoptic mange remained the dominant mange mite identified in the present study.

With regard to the origin of animals, the prevalence of mange mite infestation was 27.08%, 31.25%, 34.37%, and 22% in Emela Dawe Ajo, Birbirsa Dogoma, Melka Nega, and Nega File, respectively. The origin of the animals contributed to variations in the prevalence of mange mite infestation. Emela Dawe Ajo and Birbirsa Dogoma kebeles are agro-climatically classified as highland areas, whereas Melka Nega and Nega File kebeles are classified as midland areas. This finding is somewhat similar to studies conducted in South Wollo [29] and Wolaita [27]. However, there was no statistically significant difference (P > 0.05) between the two agro-ecological zones, indicating that the distribution of mange mites may occur independently and can infest animals equally in both highland and midland climatic conditions.

The study showed that, out of 192 animals managed under an extensive production system, 78 were positive for mange mite infestation, giving a prevalence of 40.6%. In contrast, among 192 animals managed under a semi-intensive system, 42 were found positive, with a prevalence of 21.87%. The observed difference in the prevalence of mange mite infestation between extensive and semi-intensive management systems was statistically significant (P = 0.001, OR = 2.47, CI = 1.58–3.87).

Regarding seasonal variation, the prevalence of mange mite infestation was higher in the wet season 76 (39.9%) than in the dry season 31(16.15%) (Table 1). This seasonal difference was statistically significant (P = 0.0001, OR = 7.78, CI = 4.48–13.48). Mange infestation is often influenced by seasonal factors, as crowding, malnutrition, and reduced host immunity can increase susceptibility during certain periods of the year.

Our study showed that the highest prevalence was recorded in animals with a large herd size (43.75%), followed by animals with a medium herd size (23.44%)), and with a small herd (16.4%). The differences in the prevalence of mange mites among the herd sizes were statistically significant (P = 0.00, OR = 3.96, CI = 2.21–7.10). One possible reason is that as herd size increases, so doe's competition for feeding and courtship and at that time there is more contact among each other and stress when they are involved in fighting. It might be due to a variation in environment and management system, and it might also raise awareness among owners as to the need for intervention to stop the spread of the disease.

5. CONCLUSION AND RECOMMENDATIONS

The study concluded that mange mite infestation was highly prevalent and represents one of the major parasitic health problems affecting small ruminants in the study area. The high prevalence is likely associated with poor management practices, limited owner awareness, and inadequate animal health extension services. Sheep were shown to have a much higher mange mite infestation than sheep in the current investigation. Mange mite infestation was found to be significantly associated Age, with the species of animal, season, sex and body condition of the mites. *Sarcoptese scabei var Caprae* was the most crucial mange mite of small ruminants.

- Based up on the above conclusion the following recommendations were forwarded:
- The district ought to implement regular management procedures and strategic acaricide treatment of infested sheep and goats
- It is crucial for extension programs to raise public awareness about the economic impact and seasonal dynamics of the disease.
- Seasonal fluctuations in the occurrence of manges mites in small ruminants in the area should further studied to develop effective control measures
- Further study should also be conducted to quantify financial impact of mange in small ruminants.

Abbreviations

BD = Birbirsa Dogoma

BD = Birbirsa Dogoma

CSA= Central Statistics Authority

EDA = Emela Dawe Ajo

EDA = Emala Dawe Ajo

FAO = Food and Agricultural Organizations

MND = Melk Nega Dembi

MND = Melka Nega Dembi

MoARD = Ministry of Agriculture and Rural Development

NF = Nega File

SPSS = Statistics Package for Social Science

X^2= Chi-square

Declarations

Ethics Approval and Consent to Participate

The study was conducted in accordance with the ethical principles and guidelines for the care and use of animals in research. Ethical approval was obtained from the from Ethical review committee by Woldia university, Ethiopia. All procedures involving animals were performed according to the approved protocol, and all efforts were made to minimize animal suffering.

Consent to participate was not applicable because this study involved animals and not human participants.

Consent to Publish

Permission for sample collection was obtained verbally from the owners of the household-owned sheep and goat flocks before collecting the samples. The owners were informed about the purpose of the study, and their consent was obtained prior to sample collection.

Data Availability

The data that support the findings of this study are available from the authors based on request

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Conpeting Interest

The authors declare that they have no competing interests

Authors' contribution

Assaye Desta and Misgane Fekede have generated the proposal. Both participated in designing the treatment and laboratory test protocol, statistical data analysis, follow-up and write-up of the draft manuscript; reviewed and edited the documents. Both authors have read and approved the final version of the manuscript for publication. Animaw Andargie Worku, Getachew Tadesse Ashenafi Wondye Dagne, Teketay Bayleyegn Derso, Asmamaw Bihonegn, Yihenew Getahun Ambaw and Asaye Wolelie Fentie participated in data curation.

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Figures

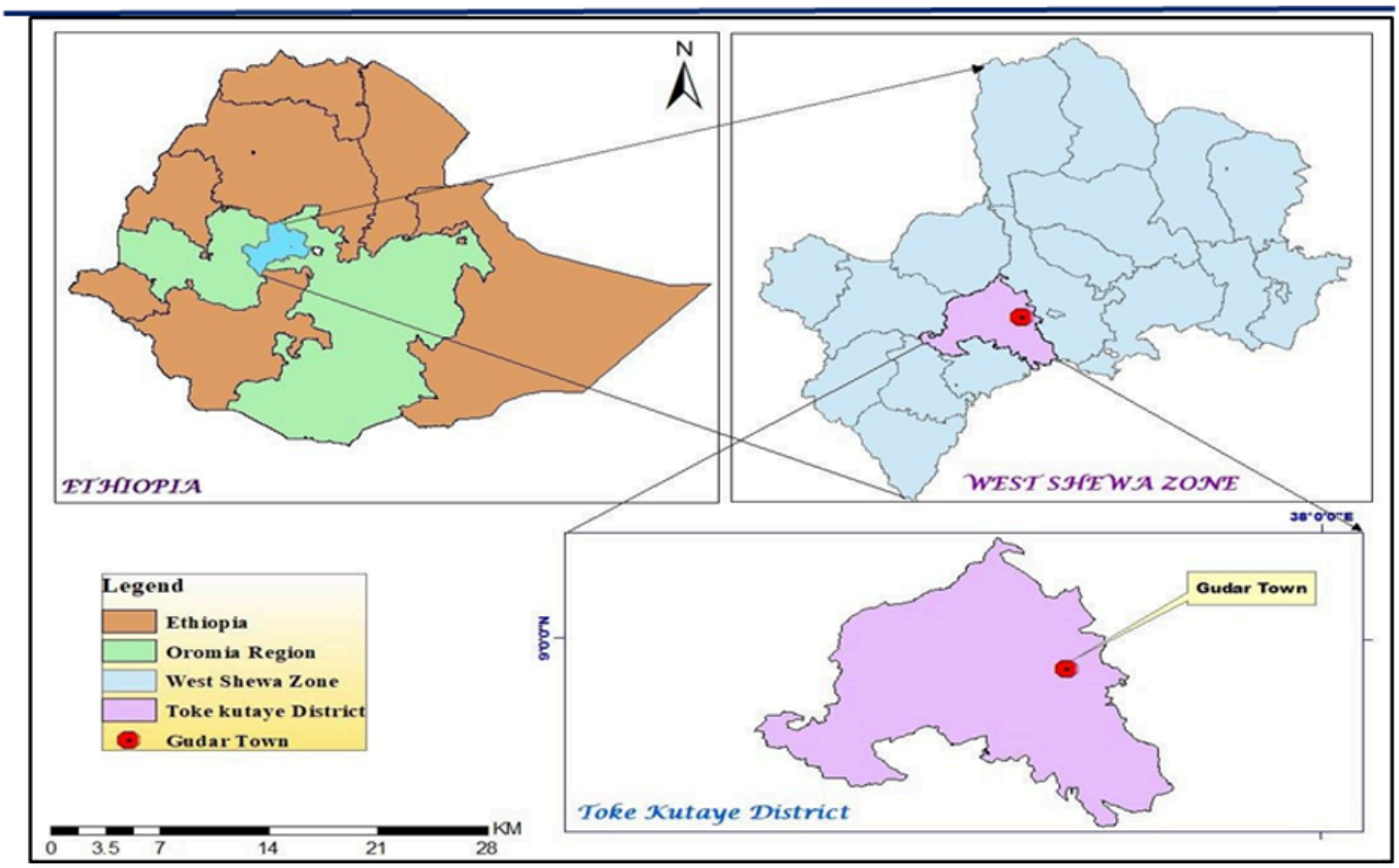


Figure 1

Map showing the study area; Guder Town [21].