PREVALENCE, ECONOMIC IMPACT, PUBLIC HEALTH SIGNIFICANT AND COMMUNITY PERCEPTION ON CYSTICERCUS BOVIS AT ASSOSA TOWN IN BENISHANGUL GUMUZ REGION, ETHIOPIA

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Abstract: Across sectional study was conducted between November 2024 to June 2025 to estimate the prevalence of Cysticercus bovis from abattoir survey and Taeniasis within the society found in and around Assosa town. Active abattoir survey and questionnaire survey were performed to accomplish the study. Of the total of 384 inspected cattle carcasses, 83 had varying number of C. bovis giving an overall prevalence of 21.61 % (83/ 384). Distribution of the cyst showed that highest proportions of C. bovis cyst were observed in shoulder (36.14%), heart (30.12%), tongue (15.66%), Lung (8.43%), masseter (6.02%), liver (3.61%). From the total of 83 cysts counted, 60.24% (50), 33.73% (28) and 6.02% (5) were small, medium, and large, respectively which was non -significantly associated ($p>0.05$). Of 83 cysticercus bovis collected, sterility and viability testing, 43(51.80%) of them were fertile, and 40(46.98%) were non-fertile; out the fertile cysts, 17 (39.53%) were viable and 26 (60.46%) non-viable; again, among the non-fertile, 32(80%) sterile and 8 (20%) calcified (Table 4). Overall, 36% of human Taeniasis retrospective data was analyzed in Assosa General Hospital (2023-2025Years). Of the total 100 interviewed respondents who participated in this study, 40% (40/100) had contracted *T. saginata* infection. Proportion among different factors of respondents were analyzed and showed higher proportion in male (35.3%), >34 years (33.33%), and in those who consume raw meat (39.70%). No significant difference between most of the risk factors (sex, meat consumption habit, marital, and religion) ($P>0.05$). However, higher chance of getting taeniasis with illiterate (60%) was seen followed by college (51.42%), and high school (43.24%) showed with a slight significance difference ($p<0.05$). Therefore, the study revealed the presence of bovine cysticercosis, economic impact, and its public health hazards need increased knowledge, attitude and practices and awareness of the health impact of taeniasis (cysticercosis) and safeguard the community.

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1. INTRODUCTION

1.1. Background

Ethiopia is well known for its livestock population that stands 1st in Africa and 10th in the world. The livestock sector plays a great role in the countries total GDP as the source of economy and plays a key role for the livelihood of the population as a source of meat, milk, drought power, and income. However, constraints like inadequate nutrition, disease, lack of support services hindered the sectors potential to be exploited fully (Ayalew and Amare, 2019; Yigizaw *et al*., 2017).

From constraints that challenge livestock sector many diseases are directly affect the livestock production in Ethiopia. Among the many prevalent livestock diseases, parasitism is one of the most important challenges in tropics. *Taenia saginata* is one of the parasites that causes significant economic losses to the livestock industry and has public health importance. Adult stage of parasite affect human was as larval stage affect cattle (Rossi *et al*., 2017). The metacestode stage of *T. Saginata* is bovine cysticercosis which is a zoonotic disease transmitted to humans through raw or undercooked meat consumption (Tegegne *et al*., 2018). The tradition of raw meat consumption mixed with poor hygienic practices are the major reasons for the increased incidence of bovine cysticercosis and taeniasis infections (Kumar and Tadesse, 2011).

Bovine cysticercosis is universally distributed in developing as well as in developed countries. As per an estimate, 50 million cases of such infestation occur worldwide with 50,000 people dying from this problem annually. In humans, the disease is called as taeniasis which is accompanied with symptoms like nausea, abdominal discomfort, epigastric pain, diarrhea, excessive appetite or loss of appetite, weakness, loss of weight and intestinal blockage ((Tegegne *et al*., 2018).

In cattle, natural infections are normally asymptomatic but they cause financial losses to the cattle industry due to downgrading, condemnation, extra handling, refrigeration and transport of the infected carcasses. The tradition of raw meat consumption mixed with poor hygienic practices are the major reasons for the increased incidence of bovine cysticercosis and taeniasis infections (Minerva *et al*., 2016).

In developing countries like Ethiopia, taeniasis or bovine cysticercosis constitutes a serious but less recognized public health problem. Due to the habit of eating raw or undercooked beef dishes such as kourt and kitffo, taeniasis in human is common in Ethiopia. A high prevalence of human infection in different agro-climatic zones of the country has been reported. Low availability of taenicides is a constraint and the use of herbal drugs do not eliminate this parasite from human population and the proglottids are passed out with the fecal matter resulting in cysticercosis in the cattle (Kebede, 2008).

The diagnosis of bovine cysticercosis by meat inspection depends very much on the skills and motivation of the meat inspector, which results in important differences in the efficacy of the meat inspection from one slaughterhouse to the other. Secondly, a substantial number of infected carcasses are not detected because incisions in the so called sites of predilection cannot be many due to country regulations/economic reasons. True prevalence of bovine cysticercosis detected by the classical meat inspection techniques is underestimated by different factor. Effective meat inspection increase area and number of predilection sites like hind limbs, fore limbs, liver, chest, heart, lumbar, pelvis, tongue, lungs, neck and back, head and diaphragm to be observed and concluded that all the parts of various carcasses were equally important as predilection sites for cysticerci and could be equally inspected during routine meat inspection at slaughterhouses. Development of an efficient sero-diagnostic test in the live animal would obviate much of unnecessary mutilation and transform current meat inspection (Abuseir et *al*., 2006; Abunna *et al*., 2007).

Unavailability of prevention and control strategies like proper health education system and poor husbandry practices are accounted as barriers for the control of this infection in animals and humans. These conditions make this infection more common in developing countries and more prominent in developing counties than the developed world (Kumar and Tadesse, 2011).

1.2. Statement of the problem

Numerous abattoir-based survey studies have been conducted in Ethiopia to estimate the prevalence of *C. bovis*. Official meat inspection reports are considered to be an underestimation of the real prevalence as meat inspection has a low sensitivity for the detection of cysts in muscles. The precision of the visual identification is also questionable, as the cysticerci can be confused with lesions caused by infections with Sarcocystis spp. and Actinobacillus spp. or with other local alterations (Ogunremi *et al*., 2004). Besides, considerable amount of economic losses approaching 30% due to bovine cysticercosis from carcass weight loss and the cost of freezing for the infected meat, investigation, grade of the infected animals from markets, and treatment costs for detained carcass accounted huge in Africa. Moreover, medical costs for taeniasis treatment of infected human and cost of taenicidal drugs are also reported. In Ethiopia, treatment cost of 4,937,583.21 ETB (225,036.97 USD) has been estimated (Grindle, 2012).

In Ethiopia, the presence of *T. saginata* has been known for centuries, yet data on the occurrence of this zoonosis are scarce, fragmentary and inaccurate with variations regarding the levels of infection in different parts of the countries. The studies were fragmented in terms of utilizing previous study results and there was a redundancy in investigating the occurrence of the parasite. In addition, there was no summarized report of the parasite at the national level. This systematic review and meta-analysis of the prevalence of *C. bovis* in Ethiopia aims to provide a national level prevalence of the parasite by pooling estimates of the prevalence of *C. bovis* from reports conducted in different parts of the country.

In Ethiopia with a prevalence of Bovine cysticercosis were reported from different areas like 9.7% in Bishoftu (Amsalu, 2013), 21% in Nekemte (Issa, 1990), 6.4% in Kombolcha (Tewodros *et al*., 2015), 4.9% in Asela (Elemo *et al*., 2017), and 3.2% in Ethiopian different agro climatic zones (Tegegne *et al*., 2017). However, prevalence, public health significant and community perception about zoonosis of cysticercus bovis in Assosa town were not yet assessed well. This study will be aimed to the following objectives in study area.

1.3. Objectives

1.3.1. General objectives

- To determine prevalence, public health significant and community perception about zoonosis of cysticercus bovis in Assosa town

1.3.2. Specific objectives

- To determine prevalence and associated risk factors of cysticercus bovis in study area
- To determine community perception about zoonosis of cysticercus bovis in Assosa town

2. MATERIALS AND METHODS

2.1. Study Area

The study was conducted in Assosa Zone of Benishangul Gumuz regional state, which is located in the west and North West part of Ethiopia, between latitude $9^0$and 11^oNorth and longitude 34^o and 35^oEast. Assosa is the capital city of Benshangul Gumiz regional state and it is about 675km from Addis Ababa. It has common boundaries with Amhara and Oromia in the north, Sudan in the west and Gambela in the south. According to the Assosa district Agricultural and Rural Development Office, the district is divided in to 82 peasant associations (PA) with total populations of 92,144. The district is located in 580- 1500 meter above sea level, wet temperature of 19°C-34°C. The average rain fall is 900-1200mm annually and the total area of the district is about 2317km^2. The total livestock of the region is estimated as: 309,629 cattle, 58767 sheep, 200 470 goat 559 horses, 30 952 donkeys, 1394 mules, 15 camels and 981,196 poultry (CSA, 2015).

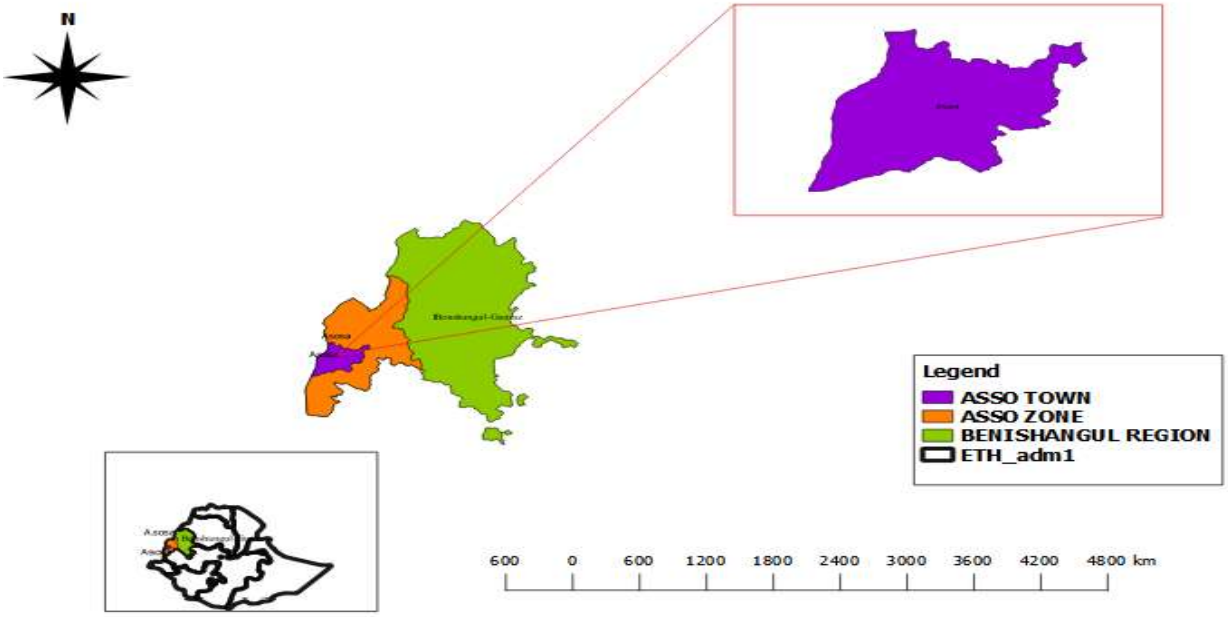


Figure 1: Map of study area
Source: Supported by QGIS version 2.14.10-Essen

2.2. Study Design

A cross - sectional study was carried out on cattle slaughtered at Assosa municipal abattoir from November 2024 to June 2025 to determine prevalence, identify potential risk factors and Knowledge, attitude and beef consuming practices of the community of C. bovis.

2.3 Study Population

The study animals were cattle of both sexes brought to the Assosa municipal abattoir for slaughter. These animals were bought from different districts around Assosa town. To study the public importance of Taeniasis, the study population was consists of randomly selected human inhabitant population in Assosa Town interviewed for the questionnaire survey and a retrospective study, which was based on data gathered at Assosa hospital is used to determine the occurrence of Taeniasis in human population in the study area.

2.4 Sample Size Determination

The sample size was calculated using the formula recommended by Thrusfield (2018). The formula used for the calculation was:

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

Where: n= required sample size
Pexp= expected prevalence
d= desired absolute precision

Therefore, accordingly 384 cattles were sampled.

2.5 Data Collection Method

A cross sectional study was conducted during detail meat inspection based on systematic randomly selected 384 cattle slaughtered at Assosa municipal abattoir. Before slaughtering and inspecting the animals, ante mortem inspection was carried out and the ID number of each animal was recorded. Ante mortem examination on individual animals is done for the records of age, sex, breed and their place of origin. During postmortem inspection, visualization and palpation of the organs followed by incision of organs was made to examine for the presence of C. bovis, according to the guideline by (FAO, 2005) for masseter muscle, deep linear incision is made parallel to the mandible; the heart is incised from base to apex to open the pericardium and incise also made in the cardiac muscle for detail examination. Deep, adjacent and parallel incisions were made above the point elbow in the shoulder muscle. Examination of the kidney, liver, and the lung was conducted accordingly.

2.6 Questionnaire survey

To determine associated risk factors of taeniasis respondents was selected using simple random sampling methods based on willingness to participate on questionnaire survey. Respondents identified for this study was questioned on their habit of raw meat consumption, religion, educational status, age, sex, marital status; knowledge of *T. saginata* of respondents was registered as possible risk factors.

2.7 Retrospective Data Survey

Data on human Taeniasis from 2023 to 2025 was collected from the parasitological laboratory recording books at Assosa hospital. Taenia positive patients out of the total patients examined for their stool was included in the data of this study. Also the number of males and females and age of positive patients was recorded.

2.8 Data management and Analysis

The Data collected from both abattoir survey and hospital was recorded on Excel spread sheet and preliminary descriptive analysis such as prevalence of C. bovis related to specific factors (origin, sex, body condition and age of animals) was calculated to assess the strength of association of different risk factors to the occurrence of infection and statistical analysis was performed by using STATA version 17. The occurrence of C. bovis infection was calculated by dividing the number of animals harboring a cyst by the total number of animals examined. The outcome variables for the abattoir study was cases of C.bovis detected during routine postmortem inspection. The association between the risk factors and the outcome variables was assessed using chi-square test. Hospital data are arranged and analyzed. In all the analyses, confidence level was held at 95% and $P< 0.05$ was set for significance.

3. RESULTS

3.1 Prevalence of Bovine Cysticercus bovis

The overall prevalence of **Cysticercus Bovis** among cattle slaughtered and examined at Assosa municipality abattoir was found to be 21.61% (83/384). There was significant difference in **Cysticercus bovis** prevalence and risk factor such as organ categories, age, body condition, and **origin** of cattle (P<0.05); whereas, there was non-significant variation (P >0.05) in **cysticercus bovis** prevalence and risk factor (sex, breed, cyst size, cyst size).

Among different risk factors, higher **Cyst occurrence** was recorded (24.33%) in age ranging b/n 5-9years, followed by (23.52%) in greater than 9 years while the 13.33% of cyst occurrence was recorded in 3-5 years group of cattle which was significant (P<0.05). Higher cyst occurrence was recorded in cattle with poor body conditions (47.61%) followed by medium (23.52%) and good body condition scores (18.06%), which was significant (P<0.006). Based on the origin of cattle, Cysticercus bovis occurrence was 23.72% in **Assosa town, 24.27% in keshmando, 13.97 % in Urea and Abrahamo area** (Table1), which was significantly associated (P<0.05). The cysts had the tendency to be located more in shoulder (36.14%); followed by heart (30.12%); Tongue (15.66%); Lung (8.43%), (6.02%) massetor and (3.61%) liver in the present study as indicated in Table 2.

Table 1. Occurrence of Bovine cysticercus bovis on the basis of associated risk factors

Variables	Categories	No. Examined	No. Positive	Prev.%	CHI2	P -value
Breed	Local	**330**	**72**	**22.81**	**0.03**	**0.86**
	Cross	**53**	**11**	**20.75**		
Sex	Female	**39**	**11**	**28.20**	**1.11**	**0.29**
	Male	**345**	**72**	**20.86**		
Age	3-5yr	**90**	**12**	**13.33**	**4.7**	**0.05**
	5-9yr	**226**	**55**	**24.33**		
	>9yr	**68**	**16**	**23.52**		
BCS	Good	**227**	**41**	**18.06**	**10.36**	**0.006**
	Medium	**136**	**32**	**23.52**		
	Poor	**21**	**10**	**47.61**		
Origin	*Assosa twon*	**118**	**28**	**23.72**	**4.23**	**0.05**
	Keshmando	173	42	24.27		
	Ura area	**93**	**13**	**13.97**		
Cyst size	*Small*	**260**	**51**	**19.23**	**1.96**	**0.37**
	Medium	**111**	**29**	**26.12**		
	Large	**13**	**3**	**23.07**		

Table 2: Proportions of cysts occurrence in inspected organs at Assosa municipal abattoir (n=384)

Risk factors	Categories	No. examined	Positives	Proportions
Breed	Local	330	72	21.81
	Cross	54	11	20.37
Sex	Female	39	11	28.20
	Male	345	72	20.86
Bcs	Good	227	41	18.06
	medium	136	32	23.52
	Poor	21	10	47.61
Age	3-5year	90	12	13.33
	5-9year	229	55	24.02
	>9 year	65	16	24.62
Origin	Assosa town	118	28	23.72
	Keshmando	173	42	24.27
	Urea area	93	13	13.97

3.2 Anatomical Distribution of Cysts and size of Cysticercus bovis

Analysis of active abattoir survey showed that there was a variation in the infected anatomical distribution of cysticerci in organs inspected. Of the organs examined, the highest proportion of C. bovis cysts were observed in the shoulder (36.14%), followed by heart (30.12%), tongue (15.66%), lung (8.43%), massetor (6.02%) and liver (3.61%) (Table3). From the total of 83 cysts counted, 60.24% (50), 33.73% (28) and 6.02% (5) were small, medium, and large, respectively (Table 3).

Table 3: Frequency of Anatomical distribution of C. bovis (n=384)

Organ affected	No. affected	Prevalence	Proportion
Shoulder	30	7.81	36.14%
massetor	5	1.30	6.02%
Heart	25	6.51	30.12%
Tongue	13	3.38	15.66%
liver	3	0.78	3.61%
Lung	7	1.82	8.43%
Total	**83**	**21.61**	**100**

3.3 Sterility and Viability characterization of C. Bovis

From the total 83 Cysticercus bovis collected at the abattoir during postmortem examination and subjected to sterility and viability testing, 43(51.80%) of them were fertile, and 40(46.98%) were non-fertile; out the fertile cysts, 17 (39.53%) were viable and 26 (60.46%) non-viable; again, among the non-fertile, 32(80%) sterile and 8 (20%) calcified (Table 4).

Table 4. Number and size of Cysticercus bovis observed in different organs at Assosa municipal abattoir.

Organ	Large		Medium		Small		Total account	
	No.	%	No.	%	No.	%	No.	%
Shoulder	1	20	9	32.14	20	40	30	36.14
Lung	0	0	2	7.14	5	10	7	8.43
Heart	2	40	10	35.71	13	26	25	30.12
massetor	1	20	1	3.57	3	6	5	6.02
Tongue	1	20	5	17.85	7	14	13	15.66
Liver	0	0	1	3.57	2	4	3	3.61
Total	5	100	28	100	50	100	83	100

Table 5. Bovine Cysticercus bovis fertility and Viability in different organs at Assosa at municipal abattoir

Organ	Fertility 43 (51.80%)		Non fertility 40(46.98%)		Total
	Viability	non viability	Sterile	Calcified	
Lung	2	3	2	0	7
shoulder	6	7	13	4	30
Heart	5	7	10	3	25
massetor	1	2	1	1	5
Tongue	2	6	5	0	13
Liver	1	1	1	0	3
Total	**17 (39.53%)**	**26 (60.46%)**	**32(80%)**	**8 (20%)**	**83**

As described in Table 6, majority of the viable cysts were recorded in lung (28.6%), liver (33.33%), shoulder 6(20%), heart 5(20%), massetor 1(20%) and followed by Tongue 2(15.38%).

Table 6. Proportions of Viable Cyst in different organs inspected

Organs	No. of cysts	Viable cysts	Proportions (%) viable cysts
Lung	7	2	28.57
Shoulder	30	6	20
Heart	25	5	20
massetor	5	1	20
Tongue	13	2	15.38
liver	3	1	33.33
Total	83	17	20.48

Table 7. **Financial loss assessment in Cattle due to Cysticercus bovis**

Organ	No. of organ condemned	Price per organ		Total price (ETB)
Lung	7	8.43%	50	421.5
shoulder	30	36.14 %	50	1,807
Heart	25	30.12%	50	1506
massetor	5	6.02%	100	602
Tongue	13	15.66	100	1566
Liver	3	3.61	100	361
Total	83	100		6,263.5

3.4 Economic losses

From the total of 384 cattle examined, 83 (21.61%) were found harboring Cysticercus bovis. Among them (30)36.14%, (5)6.02%, (25)30.12%, (13)15.66%, (3)3.61% and (7)3.61% of the Cysticercus Bovis were located in shoulder, massetor, heart, tongue, liver, and lung was found, respectively. From the total of 83 cysts counted, 60.24% (50), 33.73% (28) and 6.02% (5) were small, medium, and large, respectively (Table 3).

The overall occurrence of Cysticercus bovis and percentage involvement of in shoulder, heart, tongue, masseter, liver and lung were used as input to estimate the financial loss attributable to organs condemned in the present study.
In Assosa town average market price of cattle lung, liver, heart, tongue, massetor and Shoulder muscles a kilogram of beef was found to be 50, 50, 50, 100, 100,100 and 600 Ethiopian Birr (ETB) respectively. The mean annual numbers of cattle slaughtered at Assosa municipal abattoir during the last two years was **2830**, and the overall occurrence of cysticercus bovis was found 83/384(21.61%) during the study period.
Hence, direct financial losses due to condemnation of organs and indirect financial losses due to carcass weight loss were calculated as follows on annual basis.
DL = (AS × PLu × CLu) + (AS × PLi × CLi) + (AS × Pmass × Cmass) + (AS × PHr × CHr) + (As xPsho x Cl sho)+ (As xPtong xCtong)
= (2830 × 50 × 0.084) + (2830 × 50 × 0.361) + (2830 × 100 × 0.060) + (2830 × 50 × 0.301)+(2830 x100 x 0.036)+ (2830 x100 x0.156)
DL = (11,886) + (51,081) + (16,980)+ (42,591) +(10,188)+(44,148)= **176, 874** ETB.
Where;
DL = direct losses associated with cysticercus bovis,
AS = estimated mean annual slaughter;
PLu = percent involvement of the lung;
CLu = local retail price of a lung;
PLi = percent involvement of the liver;
CLi = local retail price of a liver;
P sho = percent involvement of the triceps;
Csho = local retail price of shoulder;
PHr = percent involvement of the heart;
CHr = local retail price of a heart.
Pmassetor = percent involvement of the massetor;
Cmassator = local retail price of a massetor.

Ptong = percent involvement of the tong;
Ctong = local retail price of a tong
Indirect losses (IL) = 5%NAS × PH × CPB × 126 kg (0.05 × 2830 × 0.216 × 600 × 126) = **2,310,638.4 ETB** ($15,404.25).
Where 5% = A reduction of 5% in meat production due to Cysticercus bovis
NAS = average number of cattle slaughtered annually;
PH = Prevalence of Cysticercus bovis ;
CPB = current average price of 1 kg of beef at Assosa;
126 kg is the dressed average carcass weight of adult cattle.

Total economic loss (TL):
The total economic loss can be evaluated by considering both DL and IL as follows:
TL = DL + IL (**176, 874** + 2,310,638.4) = 2,487,512.4 ETB (16,583,4 USD) (Table 5).

3.5 **Community perception and Public Health associated with Taeniasis**

Questionnaire survey on human teaniasis occurrence and its associated factors was administered on 100 randomly selected volunteer respondents from Banbasi town and adjoining areas from whom pre-informed consents were obtained. The predisposing factors of taeniasis such as age, sex, religion, occupation, educational levels (illiterate, primary school, secondary school, preparatory stage, college and university), habit of raw meat consumption, presence and usage of sanitary facilities especially toilet and knowledge of Taenia saginata were assessed. Following detailed discussion on the objectives of the study with each participants, the interview was conducted face to face.

Of the total 100 interviewed respondents who participated in this study, 40% (40/100) had contracted T. saginata infection. Proportion among different factors of respondents were analyzed and showed higher proportion in male (35.3%), >34 years (33.33%), and in those who consume raw meat (39.70%). Further analysis showed no significant difference between most of the risk factors (sex, meat consumption habit, marital, and religion) (P>0.05). However, respondents with illiterate (60%), college (51.42%), and high school (43.24%) showed high proportion with a slight significance difference (p<0.05) as shown in Table 8.

Table 8. Proportion of Taeniasis among the interviewed respondents in Assosa city, (n=100)

Risk factors	Categories	No. of interviewed (Infected)	Proportions	CHI2	P - value
Sex	Female	37 (13)	35.13	0.57	0.44
	Male	63(27)	42.85		
Age	16-25	31 (9)	29.03	11.08	0.004
	25-35	21(15)	71.42		
	>35	48(16)	33.33		
Education level	Illiterate	5(3)	60	9.66	0.022
	Primary	23(5)	21.73		
	Secondary	37(14)	37.83		
	College	35(18)	51.42		
Consumption habit	Cooked	32(13)	40.62	0.007	0.93
	Raw	68(27)	39.70		
Residence	Rural	44(38)	86.36	70.37	0.000
	Urban	56(2)	3.57		
Toilet Usage	No	7(2)	28.57	5.01	0.025
	Yes	93(38)	40.86		
Marital	married	51 (20)	39.21	0.026	0.87
	single	49(20)	40.81		
Religion	Christian	52(24)	46.15	1.64	0.20
	Muslims	48(16)	33.33		

As Table 8 indicated, of 100 respondents, 58 % of respondents said as they eat raw meat and 42% of respondents was not eat raw meat in the areas, which was significant(P<0.05).Consistently, 71% of respondents was got Taeniasis while 29% of respondents was not got diseases and the disease was statistically significantly associated (P<0.05). During the questionnaire survey of respondents 40%, 20%, 15%, 7%, 13%, and 5% of the Taeniasis clinical signs: abdominal pain, Diarrhea, Discomfort, Nausea, digestive disturbance and anorexia respectively were recorded in the interviewers. 51% of the respondents were habit of raw meat consumption while 49% was no habit of raw meat consumption, which was no significant (P>0.05). Knowledge of community about zoonotic risk of Taeniasis was 48% moderate and 25% high and 27% low.

Table 9. Knowledge, attitude and beef consumption practices of respondents

No.	Categories	No. interviewed	Chi2	P –value
I	Knowledge, attitude and beef consumption practices			
6	Do you eat raw meat			
a.	Yes	58	32.18	0.000
b.	No	42		
7	If yes, how many times do you eat per month			
a.	more than two times per month	20	38.11	0.000
b.	Less than one times per month	20		
c.	less than one times per mth	2		
d.	one times per month	50		
8	Do you get a disease condition?			
a.	Yes	71	8.20	0.004
b.	No	29		
9	If yes, what are the clinical signs do you show?		7.57	0.056
	a. Abdominal pain	40		
	b. Diarrhea	20		
	c. Discomfort	15		
	d. Nausea	7		
	e. Digestive disturbance	13		
	f. Anorexia	5		
10	Do you get laboratory diagnosis?			
	a. Yes	41	3.34	0.067
	b. No	59		
11	Is treatment given for infected person with Taeniasis			
	a. Yes	63	52.55	0.000
	b. No	37		
12	Tape worm effective treatment given			
	a. Niclosamide	18	1.43	0.69
	b. Praziquantel	29		
	c. Mebendazole	19		
	d. Albendazole	23		
	e. Other (traditional medicine)	11		
13	Occupational level of respondents			
	a. government worker	35	31.87	0.000
	b. Student	10		
	c. Merchant	22		
	d. Farmer	25		
	e. private worker	8		
14	Habit of raw meat consumption			
	a. Yes	51	0.04	0.84
	b. No	49		
15	Knowledge of community about zoonotic risk of T. saginata (taeniasis)			

	a. High	25	1.37	0.504
	b. Moderate	48		
	c. Low	27		
16	Hygienic conditions of slaughter house			
	a. Good	45	0.17	0.67
	b. Low	55		
17	Control and prevention of tape worm (Taenesis)			
a	Control of hygienic condition	19	9.62	0.08
b	Control of pasture contamination by feces	19		
c	Cooking beef	13		
d	Freezing meat	14		
e	Improving Livestock farming techniques	15		
f	Routine meat inspection	20		
18	Transmission methods			
a.	Infected with meat parasitic zoonosis	19	7.72	0.46
b.	Illiterate abattoir workers	14		
c.	Inappropriate PPE usage	22		
d.	Pasture, sewage contamination by feces	21		
e.	Habit of raw meat consumption	24		

2023- 2025 retrospective human taeniasis at Assosa General hospital indicated that, overall human taeniasis were 36%. Higher female categories (50%) were infected with taeniasis followed by male domains (25%). And also majority (50 %) of human taeniasis cases were adult age groups whereas 33.33% were young age groups. Besides this, majority of the cases were originated from Abraham (42.85%); 37.5% in Homosha, 33.33% in Banbasi and and 25% in Assosa town. So that, human taeniasis was a widespread health problem in the study area with the prevalence of (36%), they were infected with T. saginata at least once in their life time. (Table10).

Table 10. Retrospective Human Taeniasis data from 2023-2025 (N=25)

Year	Factors	Categories	suspected case	confirmed	Prevalence, %
2023-2025	sex	male	8	2	25
		female	6	3	50
	age	young	9	3	33.33
		adult	2	1	50
	Origin	Assosa -01	4	1	25
		Banbasi m/49	6	2	33.33
		Homosha	8	3	37.5
		Abrahamo m/38	7	3	42.85
			25	9	36

(Source: Assosa, General Hospital, 2023-2025 retrospective data)

4. Discussion

4.1 Prevalence C. bovis

The prevalence of C. bovis among the carcasses inspected at Assosa municipal abattoir was 21.61% which is in agreement with the findings of Abunna et al. (2008) (26.25%) at Hawassa. Comparably, lower prevalence of C.bovis was reported by Tegegne *et al.* (2018) (8.97%) in Kombolcha, Moje *et al.* (2014) (10.1%) at Shashamanne; Kebede *et al*. (2009) (7.5%) and Regassa et al. (2009) (11.3%) both at Wolaita Soddo abattoirs. Besides this, as compared to present findings, lower prevalence of C. bovis were registered by Tamirat *et al*. (2018) (4.2%) at Bahir Dar, Ibrahim

and Zerihun (2012) (3.6%) at Addis Ababa abattoir, Taresa *et al*.(2011) (3.65%) at Jimma, Dawit (2004) (4.9%) at Gondar, Megersa *et al*. (2010) (4.4%) at Jimma and Bedu *et al*. (2011) (3%) at Zeway.
On the other hand this finding was higher than the 2.58% in Bahir Dar (Birhanu M et al., 2013). 2.98% from Nekemte (Abunna *et al*.,2011). 4.4% from Jimma (Megressa *et al*., 2010).
Besides this, as compared to present findings, lower prevalence of C. bovis were registered by Tamirat *et al*. (2018) (4.2%) at Bahir Dar, Ibrahim and Zerihun (2012) (3.6%) at Addis Ababa abattoir, Taresa et al.(2011) (3.65%) at Jimma, Dawit (2004) (4.9%) at Gondar, Megersa *et al*. (2010) (4.4%) at Jimma and Bedu *et al*. (2011) (3%) at Zeway. However, higher C. bovis was reported by Abunna *et al*. (2008) (26.25%) at Hawassa.

The observed difference among these studies could be explained with the agro-climatic conditions of the study areas, the number of incision made during inspection, the ability of the meat inspector to identify the C.bovis, habit or culture of raw meat consumption, sample size and sampling method, level of environmental contamination with the eggs of *T. saginata*, dose and viability of egg consumed (Scandrett et al., 2009). Low infection among the inspected animals in the present study area could be due to limited number of incisions made on the predilections sites. This may in turn lead to missing of infected animals as the sensitivity of detecting the parasite will decline with limited number of incisions (Wanzala *et al*., 2003). The presence and number of cysts in any given site varied greatly among animals and demonstrate the absence of any true predilection sites for C. bovis (Scandrett *et al*., 2009).

The present study showed that tongue, triceps muscle, Masseter, heart, lung and liver were the predilection sites for the cysts of C. bovis which is similar to the results of Megerssa et al. (2010). Regarding the anatomical distribution of the cysts, many researchers come up with different results like Abunna et al.(2008) and Getachew (1990) reported triceps as being frequently affected by the cyst, while Mulugeta (1997) found as heart as a preferable organ. However, the present study showed that the most frequently affected organ with the highest number of cysts was the tongue which is in agreement with different studies conducted in different parts of the country (Hailu, 2005; Bedu et al., 2011).

In the present study, organ fertility was 43(51.80%), and non - fertility was 40(46.98%) Viability17(39.53%); non viability 26 (60.46%); sterility 32 (80%) and calicified 8(20%). 36.14%, 8.43, 30.12%, 15.66, 3.61, and 6.02% of Cysticercus bovis was recorded in offals of shoulder, lung, heart, tongue, liver and massetor respectively. A total of 83 cysts were detected during the inspection. Of the total 83 C. bovis collected during the study period 43 (51.80%) were found to be a live while other 40(46.98%) were degenerative cyst.

Viability test of the cysts revealed that it was the liver which harbored the highest number of viable cysts (33.33%) followed by, lung (28.57%), Heart (20%), massetor (20%), shoulder (20%), and tongue (15.38%). However, the present finding was less than the findings of Lielt *et al*. (2015) and Dejene *et al*. (2017). It was also greater than the finding of Bekele *et al*. (2010) (42.9%). This findings implies, the method of meat inspection, the ability of the meat inspector to identify the cases, difference in the management, sample size and sampling method, the number of cuts, and other factors can contribute for the variation of prevalence of bovine cysticercosis. Besides, backyard slaughter is practiced in the area reducing the number of animals brought to slaughter in the abattoir. During backyard slaughter infected organs are left unburied in the field accessed for dogs and other carnivores which favor the transmission cycle of cysticercosis. The culture and tradition of inhabitants in the study area favor the keeping of dogs in periurban are as (urban and rural households) often in close association with the family and farm animals. Almost all cattle owners, shepherds and urban dwellers keep at least 1 dog to safeguard their properties from wild carnivores and thieves. These in the areas studied are considered to be conducive to the maintenance and further propagation of cysticercosis (Kebede *et al*., 2010).

4.2 Questionnaire survey of T.saginata (Taeniasis)

This study indicated that there was no association in **breed** of animals and cysticercosis infection rate. This may be due to indiscriminate exposure of animals to risk factors regardless of their **sexes and breed.** The management of cattle was the same regardless **breed and age** in an open range land subjected to equal chance of infection. Higher infection of cysticercosis was registered in 5-9 years and >9 years of cattle 23.52% and 24.33% respectively, compared to 3- 5 years (13.33%) with variable number of C. bovis observed among different organs examined which was slightly significant ($P<0.05$). This is in line with the reports of Zewdu *et al*. (2010) 22.91% old and 6.78% adult; Mandefro *et al*. (2019) 66.1% old and 29.5% adult; Akeberegn et al. (2017) 8.71% old and 2.8% adult; Kebede and

Mekonnen (2020) 43.4% old and 19.0%. The higher CB prevalence in adult and older cattle than the younger ones might be due to the persistence prolonged exposure to C. bovis scolex evaginated (metacetodes), the development of metacestodes of scolex evagination and reduced immune status as a result of longer exposure time to the eggs of the parasite in old than younger cattle.
Cattle with **poor body condition** are highly infected followed by medium and good body conditions and this result is in agreement with the findings of Melaku *et al*. (2012) and Bezuayehu et al. (2014). It was agreed with the report of Mesfin and Nuraddis (2012) (good=22.0% and medium=24.0%) but higher with the report of Abdulaziz et al., (2016) (good=7.0% and medium=15.9%) and with the study reported by Addisu and Wondimu (2015) (good=1.9% and medium=5.8%) but The reason behind low prevalence in good body condition than medium body condition might be due to the fact that most of the animals slaughtered in the abattoir were brought from fattening systems of the individual farmer, in which animals from such farms were less exposed to eggs of T. saginata as they graze on relatively clean defined pasture land; tying system to the pegs and intensive feeding system in the house for fattening purpose and use of anthelminthic drugs.

With regard to the origin of animals, the highest prevalence was observed from cattle of Keshamando kebele of Assosa zone (24.27%) and followed by 23.72% in Assosa town and the lower in the Abrahamo and Ura areas (13.97%); the study districts due to the fact that the municipality of Assosa district was frequently using strychnine poisoning to remove stray dogs in a program to reduce rabies outbreak in the district as well as there was annually mass dog vaccination in the district. This might have resulted in reducing contamination of pasture by stray dogs. This variation of prevalence could be associated with their geographical differences and likely associated with the number of animals brought to the abattoir.

In the current study cysticercosis was frequently encountered in the liver, heart, tongue, lungs, triceps and massetors. This is explained by the fact that lungs and livers possess the first great capillaries sites encountered by the migrating cysterci oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved (Kebede et al., 2009a, 2009b).

In addition, the lungs were mostly affected than any other organ this is most probable due to the fact that ruminants are slaughtered at older age. During this period the liver capillaries are dilated and most cysts directly pass to the lungs. Additionally, it is possible for the hexacant embryo to enter the lymphatic circulation and be carried via the thoracic duct to the heart and lungs in such a way the lungs may be infected before or instead of the liver (Arene, 1985).

This finding agreed with Tegegne *et al*., (2018) reported in liver. This finding was disagreement with the finding of Abdulaziz et al., (2016) reported in diaphragm, Addisu and Wondimu, (2015) reported in tongue, Kifle and Shiret (2015) reported in triceps muscle, Regassa et al., (2009) reported in heart, Nuraddis and Frew, (2012) reported in triceps muscle and Mesfin and Nuraddis, (2012) reported in tongue. The reason behind, these variations of anatomical distribution of cyst might be due to a number of factors, such as blood kinetics and animal's daily activities. Any geographical and environmental factors affecting blood kinetics and meat inspector preferential for predilection sites during meat inspection in the animal affect the distribution the cysts in different organs of the host (Lielt, E, *et al*., 2015). Moreover, these organs usually consumed raw or undercooked that could pose public health hazard in contracting taeniasis (Abunna, F.*et al*.,2008).

In the current study, the predominant size of the C. bovis was seen to be small. The high proportion of small cysts may indicate late infection of the animals due to immunological response of the host which might preclude expansion of cyst size. The fertility rate of cysts was higher in lungs than liver due to softer consistency of lung tissue which allows easier development of the cysts and favors their fertility rate (Getaw et al., 2010).

In the current study, significant association were detected between different level of educational level in which respondents with college education (51.42%) showed lower level of taeniasis compared to (60%) illiterate ($p< 0.05$). This contradicted with different researches that got association between raw meat consumption with taeniasis (Abunna et al., 2008; Megersa et al., 2010; Bedu et al., 2011; Endris and Negussie, 2011).
2023- 2025 retrospective human taeniasis at Assosa General hospital indicated that, overall human taeniasis were 36%. Higher female categories (50%) were infected with taeniasis followed by male domains (25%). And also

majority (50 %) of human taeniasis cases were adult age groups whereas 33.33% were young age groups. Besides this, majority of the cases were originated from Abraham (42.85%); 37.5% in Homosha, 33.33% in Banbasi and and 25% in Assosa town. So that, human taeniasis was a widespread health problem in the study area with the prevalence of (36%), they were infected with T. saginata at least once in their life time. This human taeniasis prevalence (36%) demonstrates the importance of taeniasis in Assosa town and its adjoining areas. This finding agreed with the result of Abdulaziz et al. (2016) in Halaba Kulito (19.0%), and agrees with the findings of others, 64.2% by Taylor et al.(2007), 51.1% by Regassa et al.(2008), 56.7% by Bedu et al. (2011). However, it was higher than the report from Kombolcha (31%) (Endris and Negussie, 2011). But the current result was less than the results of Abunna et al. (2008) in Awassa town (64.2%), Terefe et al. (2014) in Harari (60.7%), Tegegne et al.(2018) in Kombelcha (33.8%), Regassa et al. (2009) in Jimma (56.7%), Endris and Negussie, (2011) in Kombolcha (31%), Dawit et al. (2012) in Wolaita soddo (62.5%) and Regassa et al. (2009) in Wolaita soddo (50.6%). This variation of human taeniasis in different areas might be associated with the difference in occurrence of cysticercosis in cattle, the level of raw meat eating culture among societies, the meat inspection procedures and backyard slaughtering practices.

In this study, the prevalence of T. saginata was found non -significantly different between different sex of respondents ($p>0.05$). Females (35.13%) were less affected compared to male (42.85%) respondents. This findings were agreed with the reports of Kifle and Shiret (2015) in Debrebrhan, Abdulaziz et al., (2016) in Halaba Kulito, Dawit et al., (2012) in Wolaita Soddo and Tegegne et al., (2018) in Kombelcha but disgreed with that of Lielt et al., (2015) in Bishoftu,. This higher prevalence in males could be due to the habit of males consume frequently raw beef at outdoor than females in the study area leading to higher exposure of C. bovis and males usually consume raw meat more often than females while practicing backyard slaughtering. The present study also revealed that the prevalence of T. saginata was significantly associated with different age groups of respondents ($p<0.05$).

The aged groups of 25-35 years old had infection rate of 971.42%) while above 35 years old age respondents had (33.33%) higher infection rate compared to those respondents between the age group of 16-25 years (29.03%). This agreed with that of Lielt et al., (2015) in Bishoftu, Dawit et al., (2012) in Wolaita Soddo and Kifle and Shiret (2015) in Debrebrhan. But, this study disagreed with that report of Tegegne et al., (2018) in Kombolcha. This could be explained by the fact that elderly have higher chance to consume C. bovis infected raw meat in different occasions including cultural ceremonies where raw meat is served as one of the major food items while younger, in generally, have no such access.

The study revealed that occupation of the respondents had significant association with that of taeniasis ($p<0.05$). This result agreed with that reported of Kifle and Shiret, (2015) in Debrebrhan, Lielt et al., (2015) in Bishoftu. But, disagreed with the report of Abdulaziz et al., (2016) in Halaba Kulito. The prevalence of T. saginata was higher in governmental employers (35%) followed by farmers (25%), merchant (22%), students (10%) and Private employee (8%).

This is due to the fact that the high exposed groups have higher access to contact with meat and meat byproducts. As a result of this there could be a possibility of getting infection with T. saginata.

In this study there was statistically significance difference between proportions of taeniasis in different age, educational levels, occupation, residence, latrine availability, marital status, religion. However; sex and raw meat consumption habit was non significant ($p>0.05$). Previous reports from Ethiopia indicated that consumption of raw or inadequately cooked beef was strongly associated with T. saginata infection. In this study from 32 respondents who ate raw or inadequately cooked beef 13(40.62%) acquired T. saginata, confirming that 'kurt, kitffo and dullet' are all sources of viable cysts of the parasite, as found in previous studies (Endris, J. and Negussie, H. (2011), Bedu, H., et al.,2011, Megerssa, B. et al.,2010; and Abunna, F., et al., 2008). It is therefore good to focus strongly on those edible parts of the carcass used for the preparation of these traditional dishes during meat inspection and public education.

In case of educational level similar findings were reported in other studies in different year (Megerssa, B et al., 2016; Addisu, D. and Wondimu, D. (2015) and indicating insignificant infection rate among the various educational statuses. However, disagreed with studies reported in Hawassa town (Mesfin, B. and Nuradddis, I. (2012)) and in Southwest Shoa zone of Oromia Region (Adugna, T et al.,2013). This could be due to the long-time cultural habit of eating raw meat particularly that of 'kurt' and 'kitifo' in any social groups including those of the educated and even in the medical and veterinary professionals.

4.3 Economic Impact

The economic loss due to cysticercosis in the current study was the sum of direct economic loss, the loss associated with condemned organs and the indirect economic loss that is the loss associated with reduced carcass weight. The total annual economic loss was estimated to be 2,487,512.4 ETB ($16,583.4 USD) which is important to establish a health center in one district. The indirect economic loss in this study was significantly higher than direct economic loss indicating the widespread nature of cysticercosis and moderate degree of livestock infestation rate in Assosa town. Backyard slaughter, poor veterinary services, resistance to the commonly used anthelmintics (Schantz et al., 1982; Enrico Brunetti, 2023), the abundant nature of stray dogs, and wandering of animals in an open pasture allowing contact with dogs might be associated as major reasons for the exaggerated economic loss documented in the current study. Different economic losses regarding bovine cysticercosis were also reported from different parts of Ethiopia (Zewdu *et al*., 2010), 160,000.00 ETB at Ambo Municipal abattoir (Terefe *et al.*, 2012), 19,847,704.50 ETB at Addis Ababa abattoirs enterprise (Bizuwork et al., 2013), 920,378 ETB at Debra Tabor Municipal abattoir (Nasr and Pal, 2016), 1,848,849.765ETB at Kombolcha abattoir; (Hussen *et al*., 2017), 12,590.00ETB at Shashemene Municipal abattoir and Mandefro et al. (2019) reported an annual total loss of 894,505.612 ETB at Adama Municipal abattoir. These differences in various abattoirs or regions may be due to variation in the occurrence of the disease, mean annual slaughtered cattle in different abattoirs and differences in the retail market price of liver, lungs, heart, kidneys and beef.

Evaluation of the economic impact of taeniasis / cysticercosis is very difficult particularly in developing countries like Ethiopia, where necessary information is so scant and considerable proportions of infected people treat themselves with traditional herbal drugs like “kosso” and others(Abuna *et al*., 2007). While ill-health caused by the adult worms in humans gives rise to high medical costs, the economic losses due to bovine cysticercosis are mainly due to condemnation, treating beef and downgrading of infected carcasses. Economic losses from cysticercosis are determined by disease prevalence, grade of animals infested, potential markets, prices of cattle and treatment costs for detained carcasses. For the African continent, an annual loss was reported to be US$ 1.8 billion under an overall infestation rate of 7% (Kumar and Tadesse, 2011).

5. CONCLUSION AND RECOMMENDATIONS

Bovine cysticercosis is an important zoonotic disease. The occurrence of the disease both in human and animals is high and poor slaughter processes and meat handling and processing seem to aggravate the situation. Both the abattoir and the questionnaire surveys showed that bovine cysticercosis was important parasitic disease in Assosa and adjoining areas in terms of its public health implications. Animal organ distribution of the cyst incurred a health risk from a public health point of view. Variable knowledge by community of the associated risk shows the need for community education as awareness creation regarding the disease condition, consumption of raw meat, application of environmental hygiene and other associated risk factors to minimize the impact of Taenia saginata/bovine cysticercosis in the study area.

The present study showed Bovine cysticercosis to be moderately widespread disease in Assosa town and surrounding districts. The overall prevalence of the disease in this study area was 21.61% and retrospective human taeniasis prevalence was 36%. Heart, liver and tongue were the major organs harboring C. bovis than other visceral organs and most of the cysts were found to be fertile. Among the study variables considered, age, body condition and origin of animals were identified as important risk factors for the occurrence of cysticercosis in cattle. Furthermore, occurrence of fertile cysts in examined organs was high suggesting that cattle play an important role in the life cycle of this serious zoonosis and the presence of potential risks of transmission to other intermediate hosts. Moreover, the economic losses due to bovine cysticercus bovis was estimated to be 2,487,512.4 ETB ($16,583.42 USD). Hence, cattle husbandry practice should be improved such as zero-grazing, establishment of policy on dog keeping and handling including registration, treatment and elimination of stray dogs, promoting construction of abattoirs with their appropriate disposal pits and conduct an obligatory meat inspection services and further detailed investigation into genetic characterization and the basic local epidemiological factors governing the spread of cysticercosis in the region to establish regional control strategy are recommended. Therefore; based on the above conclusion, the following applicable strategic points were recommended:

Recommendations

Based on the above conclusions, the following recommendations will be forwarded

- Avoid of raw meat consumption habit due to risk of Taeniasis

- Strict meat inspection procedures not to miss the cystic parasite and public education to create awareness on its transmission methods should be implemented.
- Break lifecycle reflects the circulation of cysticercosis and taeniasis in cattle and human,
- Control of pasture, sewage contamination by human infected feces
- Improving livestock farming techniques
- . Awareness should be created in the public with regard to the zoonotic importance of bovine cysticercosis and the risk of raw meat consumption to taeniasis.
- Strict routine meat inspection of slaughtered animals should be carried out.
- The community should be intensively encouraged for construction of simple toilet to minimize contamination of pasture with human stool, so that the cycle of T. saginata interrupted.
- Moreover, close integration between medical and veterinary service is reliable to reduce the impact of the taeniasis in both human and cattle population in Assosa and its adjoining area.

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