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PREVALENCE, SPECIES COMPOSITION AND WORM BURDEN OF ABOMASAL NEMATODES OF SMALL RUMINANTS SLAUGHTERED IN HAWASSA, SOUTHERN ETHIOPIA

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ABSTRACT

The study was carried out to estimate the prevalence, species composition and worm burden of abomasal nematodes of small ruminants (sheep and goats) slaughtered in Hawassa, southern Ethiopia from November 2007 through March 2008. During this period, visceral organs (abomasums) were collected from 237 animals (125 sheep and 112 goats) slaughtered in restaurants located in Hawassa. Of these, 224 small ruminants were male and the remaining 13 were females. All the carcasses examined were from adult animals. Out of the 237 organs examined, the majority (196) were collected during the dry season and the rest were collected during the wet season. Worm recovery, species identification and determination of worm burden were carried out according to standard procedures. The results showed that the overall prevalence of abomasal nematode infections in sheep and goats was 90.4% and 77.7%, respectively. *Haemonchus contortus* and *Trichostrongylus axei* were the only worms recovered in the abomasum of the slaughtered sheep and goats. In sheep, the prevalence of *H. contortus* and *T. axei* was 80% and 79.2%, respectively. In the goats, the prevalence of *H. contortus* and *T. axei* was 67.7% and 62.6%, respectively. Significant differences ($P>0.05$) in prevalence were not found between sex of animal, months and seasons. However, there was significant difference ($P<0.05$) in prevalence between animal species. Regarding the worm burden, there were significant differences ($P<0.05$) between months and seasons. However, there were no significant differences ($P>0.05$) in the monthly mean worm counts between animal species and sex. In general, the findings of this study showed high prevalence and worm burden of *H. contortus* and *T. axei* which could potentially be among the most important nematodes affecting the productivity of small ruminants in the area. Further, molecular epidemiology and immunological studies are recommended to understand the transmission dynamics of these parasites and their larval ecology including associated factors.

Key words: Abomasum, *Haemonchus contortus*, Prevalence, Hawassa, Nematodes, *Trichostrongylus axei*, Worm burden, Sheep, Goats.

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INTRODUCTION

Gastrointestinal nematodes are recognized as major constraints to both small- and large-scale small ruminant production in developing countries [1] and these parasites pose subtle economic losses and are amongst major factors responsible for lowered levels of production in many parts of Ethiopia [2].

Infection with gastro-intestinal helminths has been studied in many countries and appropriate times for intervention with anti-helminthic drugs have been determined, but it is not so for many developing countries in the tropics. African helminthosis in small ruminants are of considerable significance in a wide range of agro-ecological zones of the continent [3]. In Ethiopia, where livestock is kept on pasture throughout the year and climatic conditions favor the development and survival of free-living stages, helminth parasites are major causes of economic loss [4, 5]. Helminth parasites, among others, are responsible for a considerable amount of pathology in small ruminants. Since different helminth species have different pathogenic effects, it is important to know which groups are present in a flock or herd in an area or region, and the factors that influence their life cycles and epidemiology [6].

From an epidemiological point of view, the infective stages, which eventually become available to the host, depend on the independent and interactive influences of several factors in the macro- and micro-environment [7]. The free-living stages of nematode parasites of grazing animals have two basic environmental requirements, namely, high temperature and high moisture. High moisture levels, particularly surface soil moisture are determined by the amount and distribution of rain and the rate of evaporation from the soil [6]. A seasonal pattern of infection of pastures occurs in the tropics where transmission of gastrointestinal nematodes is mainly restricted to the wet season. The only means to carry the infection over from one rainy season to another is through animals harboring adult worms and/or arrested (hypobiotic) larvae [3, 8, 9 10]. Once the rainy season starts, environmental conditions become favorable for the survival of the infective larval, the hypobiotic larvae mature and there is a continuous cycle of infection between the host and pasture for as long as these conditions last. Livestock husbandry systems and managerial practices have a major influence on the transmissibility of infection to a susceptible host population. In most traditional systems, where animals are kept extensively, fecal contamination and infective stages are thinly spread over a large territory, and heavy infections rarely occur [6]. In a study of traditionally managed small ruminants confined in sheds and zero-grazed throughout the rainy season, but allowed to roam freely during the dry periods, an escalating worm burden and fecal egg counts during the wet periods and the opposite occurring during the latter seasons have been reported [11].

Age influences the susceptibility to and the pathogenicity of helminth infections. Neonates are generally incapable of responding immunologically to nematode parasites [9]. Traditionally managed flocks contain a disproportionate number of old, largely female stock, which are in contact with their young from birth till the next pregnancy or sometimes parturition, a situation which assists the maintenance and transmission of infection [12]. Abomasal nematodes and liver flukes are believed to be the most

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prevalent and widely distributed helminthes, and from the abomasal nematode, *Haemonschus contorts,* is particularly important and causes severe anemia and sometimes death in infected animals [12].

Even though the losses incurred by the parasites are believed to be significant, accurate and up-to-date estimates of the economic impacts are lacking in Ethiopia. Available information revealed that infections due to abomasal nematodes, especially *Haemonschus conotrtus,* are responsible for important morbidities and mortalities in sheep and goats in different parts of the country [13, 14]. Yearly losses amounting to USD 82 million due to endoparasites have been reported in Ethiopia [15]. Similarly, it has been reported that *H. contortus* alone is responsible for annual loss of USD 26 and 45 million in Kenya and South Africa, respectively [16].

Of the endoparasites, the abomasal nematodes, *Haemonschus contortus,* is incriminated as a dominant cause of parasitic gastroenteritis and exerts a severe economic toll in sheep and goats in Ethiopia [13]. Therefore, comprehensive information on regional and national basis on this widely distributed, most pathogenic and economically important abomasal nematodes such as *H. contortus* can be used as a baseline data to design a sound helminth control strategy [17]. The objectives of this study were, therefore, to estimate the prevalence, species composition and worm burden of abomasal nematodes of sheep and goats slaughtered in Hawassa, southern Ethiopia and to determine whether there are any significant variations of prevalence of abomasal nematodes among different species, sexes, months and seasons.

MATERIALS AND METHODS

Study area

This study was conducted in Hawassa town, capital city of Sidama zone, at 275 km South of Addis Ababa in Southern Nations, Nationalities and People's Region (SNNPR). Geographically, the area lies between 4°27' and 8°30' N latitude and 34° 21' and 39 ° 1' E longitude. During the study period, Hawassa received an annual average rainfall ranging from 0-41mm and with a mean temperature of the area of 11.14 °C-29.1°C. Its altitude is 1790 m above sea level [18]. The average household size is 5-6 persons [19]. The area is mainly covered by dry savanna type vegetation. The current total livestock population of Sidama zone (including Hawassa) is 1,573,318 cattle, 183,462 goats, 221,505 sheep, 49,150 horses, 43,653 donkeys, 3,959 mules, 1,196,506 poultry and 73,479 beehives [19].

Study animals

The study was conducted on adult sheep and goats (aged more than 1 year) slaughtered in different restaurants in the Hawassa township from November 2007 to March 2008. Most of the studied animals originated in Hawassa and different areas of Sidama zone. As most of these animals were obtained from different markets, it is difficult to trace the exact location of their origin.

Regular visits to restaurants in Hawassa township allowed collection of organs of sheep and goats for the study. The restaurants did the slaughtering of animals by themselves.

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As soon as possible, after removal of the alimentary tract from the body cavity, the abomasa were collected and transported to the Parasitology Laboratory of Animal Science Department in Hawassa College of Agriculture for microscopic examination.

Worm recovery, identification and counts

Worm recovery, species identification and determination of worm burden were carried out according to standard procedures [19, 20]. The abomasum were ligated at both ends and removed from omasum and duodenum. The organs were then opened along greater curvature and their contents thoroughly washed into a graduated bucket under a slow jet of water. The mucous membrane was carefully rubbed with fingers to remove any worms adhering to it. The contents and washings were made to a total volume of two liters. Then it was vigorously stirred until all the abomasal contents, mucus and water were thoroughly mixed. A total of 200ml of the contents was then transferred to the measuring cylinder in five steps of 40ml per step while stirring the mixture. The 200ml sub-sample was filtered through a sieve of 0.08mm aperture that can retain adult worms therein. Finally, about 3-4 ml of the sample was spread in a petri-dish and stained with 2-3ml of iodine solution, diluted with water and examined under a stereomicroscope (x12 magnification) for presence of nematodes, which were identified and counted. For the positive abomasal samples, the total number of worms counted in the 200ml sub-sample (aliquot) was then multiplied by 10 (factor) to get the total number of worms present in the abomasum.

Data analysis

Descriptive and analytic statistics were computed using SPSS Version 20. To estimate prevalence, differences between animal species, sexes, months and seasons, chi-square test was applied. In addition, ANOVA was used to determine the effects and relationship between abomasal worm burden and species, sexes, months and season. Statistical significance was set at $p<0.05$ in all analyses.

RESULTS AND DISCUSSION

The overall prevalence of abomasal nematodes (*H. contortus* and *T. axei*) in sheep was 90.4%. Similarly, the overall prevalence of abomasal nematodes (*H. contortus* and *T. axei*) in goats was 77.7% (Table 1). In both sheep and goats, no other nematode genera were encountered. The prevalence of *H. contortus* and *T. axei* infections in sheep were 80% and 79.2%, respectively, whereas the prevalence of *H. contortus* and *T. axei* infections in goats were 67.9% and 62.5%, respectively (Table1). The high prevalence and worm load of abomasal nematodes encountered in the current study is in agreement with the results of previous studies [17]. Several authors reported more than 90% prevalence of abomasal nematodes from the eastern part of the country [21-24]. Other investigations carried out on gastrointestinal nematodes of small ruminant revealed prevalence of 52.2% in Bale [25], 90.2% in Illubabor [26], 91% in Wolayta Sodo [27], and 91.4% in Kombolcha [28] for these nematodes. However, our result is not in agreement with the findings from Saudi Arabia, which is a desert where hot dry climatic conditions prevail [29]. The present study was conducted in a relatively wet, humid climate with a variable amount of rain occurring during some months of the

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study period in Hawassa and its surrounding area in southern Ethiopia, even if the expected amount of rain was not evident during this study period.

In support of the results of the present study, earlier investigators reported that *H. contortus* constitutes the largest proportion of abomasal nematodes. Similar high prevalence of *H. contortus* was reported in Ogaden (80%) [23, 24], in Wolayta Sodo (80%) [27], in Kombolcha (83.9%) [28], in Hawassa (81.1%) [17], in Saudi Arabia [29] in Wellega (88.2%) [26], and 96.5% in eastern part of Ethiopia [22]. Haemonchus was regarded as the most important parasite against which worm control is primarily targeted in Kenya [30] and prevalence of 77.8-100% in Nigeria [11]. Hemonchus is considered a significantly important pathogenic nematode worldwide because of its high biotic potential, its prominent ability of emerging in anthelmintic resistance, its considerable biological and ecological plasticity and its ability of causing losses in most classes of animals [24].

In the present study, there were statistically significant differences ($P < 0.05$) in the prevalence of both abomasal nematodes in different species. This difference could be attributed to the difference in grazing habits of sheep and goats. Sheep are exposed to the third infective larval stage (L_3) infection more frequently than goats as they graze on pasture, while goats prefer browsing to grazing. Whereas insignificant difference ($P>0.05$) in overall prevalence of abomasal nematodes was recorded between sex, month and season (Tables 1, 2 and 3, and Figure 1), showing both species with respective sex sharing the same environment during different months and season are nearly equally susceptible to *H. contortus* and *T. axei*.

Examination of the prevalence of worm burden of abomasal nematodes in sheep and goats at different seasons of study period confirmed the presence of a variety of helminthes with overall prevalence of 90.24% in wet season, in which 82.9% *H. contortus* and 65.82% *T. axei* were identified. On the other hand, 83.16% of abomasal nematodes were recorded in the dry season with specific prevalence of 72.45% *H. contortus* and 72.45% of *T. axei* (Table3).

In the present study, the monthly prevalence of *H. contortus* in sheep and goats was highest in March (83%) and lowest in January (61.2%) and falls between these values for other months as shown in (Figure1). Similarly, the highest prevalence of *T. axei* was recorded in November (81.5%) and lowest in March (65.9%) (Figure1).

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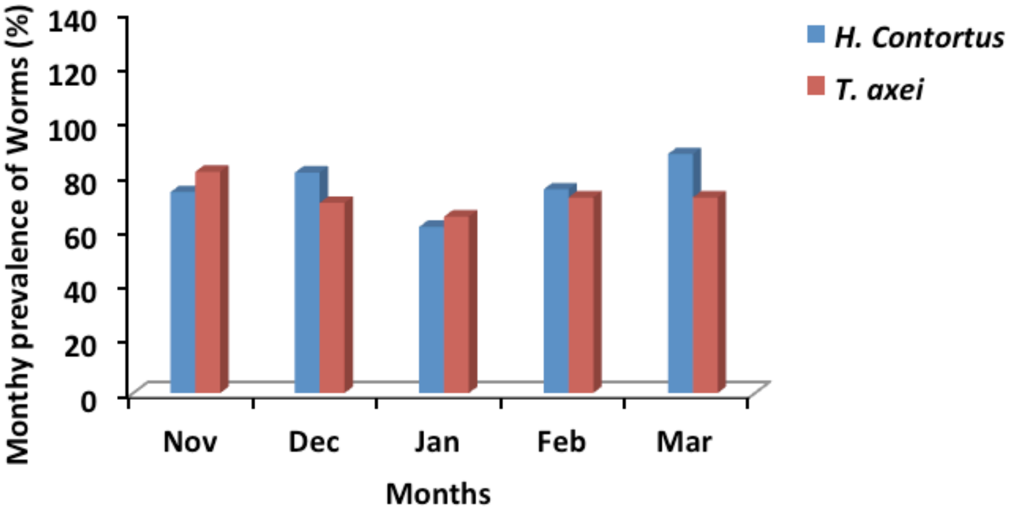

Figure 1: Monthly prevalence of *H. contortus* and *T. axei* in sheep and goats around Hawassa town (p<0.05)

This study showed the occurrence of infection in small ruminants by abomasal nematodes during the study months, suggesting the existence of pasture contamination and the availability of infective larvae during the month of the study period. This finding agrees with the previous works [14] where severe morbidity of ovine nematodes infections was reported throughout the year.

Table 4 shows the mean adult nematode counts recovered from the abomasa of slaughtered sheep and goats at different restaurants in Hawassa township, during the study period. On average, 168,160 adult *H. contortus* and 143,116 adult *T. axei* worms were recovered from sheep and goats, respectively. During the study period, 224 female and 13 male sheep and goats abomasa were examined with specific mean worm burden of *H. contortus* (164) and *T. axei* (130) for female animals, whereas a mean worm burden of *H. contortus* (170) and *T. axei* (150) for male sheep and goats were encountered (Table 5). The influence of species and sex of these target animals on the mean worm burden for each nematode species (*H. contortus* and *T. axei*) was not significant (P>0.05). On other hand, there were significant differences (P<0.05) in the mean adult worm counts of each nematode species between the months of study period, and wet and dry season, but no significant difference (P>0.05) was recorded for *H. contortus* in the dry and wet seasons (Table. 6). The worm burden increased during the dry season (November- February) and decreased during the wet season starting from March. The worm count that was carried out throughout the study period may indicate that *H. contortus* and *T. axei* were prevailing during the dry and wet seasons.

The results of the present study revealed that the highest monthly mean worm burden of *H. contortus* was recorded in December (226) and lowest in January (108). The *T. axei* burden in both species was highest in December (181) and least in March (70) (Figure 2). The results of worm count presented herein showed slightly different patterns in sheep and goats. In sheep and goats, both the overall worm count and

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specific counts for these abomasal nematodes (*H. contortus and T. axei*) showed similar trends. Higher worm loads were recorded during December, November and February than January and March months of the study period. The higher worm count was recorded in the dry season of the study period. In this study, statistical difference ($P<0.05$) was recorded for worm count between months and seasons of the study period. These higher worm counts during the months of the dry season could be associated with poor immune status of hosts due to malnutrition (lack of feed) [31].

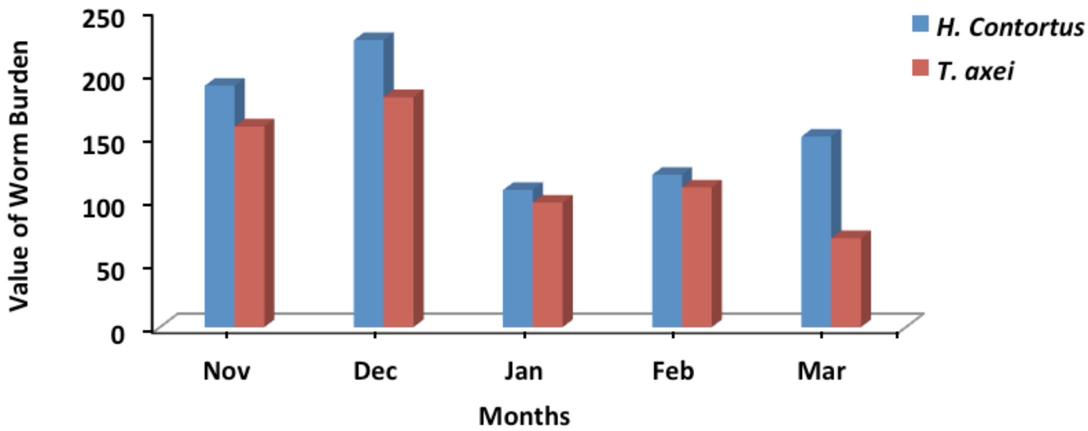

Figure 2: Monthly mean worm burden and 95% confidence interval of *H. contortus* and *T. axie* in sheep and goats (n=200), p<0.05

Overall, the results of this study indicate that abomasal nematodes are among the most important pathogenic helminthes of small ruminants.

CONCLUSIONS

This study showed that small ruminants found around Hawassa area, overall and monthly, suffer from high prevalence of abomasal nematodes infection. In both host species, *H. contortus* is particularly an important impediment to small ruminant production in the study area. Therefore, the findings of this study indicate that management of worms in sheep and goats is necessary. Effective management of worms could be achieved through integrated control methods. The management of worms may continue through the regular and strategic use of antihelminthic drugs. Susceptible sheep and goats should be dewormed at the same time before or on the onset of rain and thereafter. For sustainable worm management, an integrated approach that employs management of the communal pastures has to be practiced in order to break the major infection cycle. Management practice could include regulating the pasture to be grazed for a certain period or encouraging rotational use of the different pastures, and/or cut-and-carry feeding of animals from areas protected from grazing by sheep and goats particularly during the rainy seasons. Since *H. contortus* is the most dominant and prevalent parasite in the study area, further investigation on its epidemiology and economic losses in domestic ruminants throughout all seasons in different agro-ecology areas of the region should be carried out.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Table 1: The prevalence of *H. contortus* and *T. axei* in sheep and goats around Hawassa town

Animal species	Numbers Examined	Prevalence of *H. contortus*		Prevalence of *T. axei*		Prevalence of either of nematodes	
		Number Positive	Prevalence (%)	Number Positive	Prevalence (%)	Number Positive	Prevalence (%)
Sheep	125	100	80%	99	79.2%	113	90.4%
Goat	112	76	67.9%	70	62.5%	87	77.7%
Total	237	176	74.3%	169	71.31%	200	84.4%

There was significant difference ($p<0.05$) in *H. contortus* and *T. axei* between sheep and goats p=0.007, chi-sq =7.3, degrees of freedom=1

Table 2: The prevalence of *H. contortus* and *T. axei* in sheep and goats based on sex

Sex	Numbers Examined	Prevalence of *H. contortus*		Prevalence of *T. axei*		Prevalence of either of nematodes	
		Number Positive	Prevalence (%)	Number Positive	Prevalence (%)	Number Positive	Prevalence (%)
Male	224	167	74.6%	162	72.3%	190	84.8%
Female	13	9	69.23%	7	53.85%	10	76.9%
Total	237	176	74.3%	169	71.31%	200	84.4%

Chi-sq. =0.18; degrees of freedom=1, p=0.68. Thus there were no significant differences ($p>0.05$) in *H. contortus* and *T. axei* between both sex of sheep and goats

Table 3: The seasonal prevalence of *H. contortus* and *T. axei* in sheep and goats around Hawassa town

Seasons	Numbers Examined	Prevalence of *H. contortus*		Prevalence of *T. axei*		Prevalence of either of nematodes	
		Number Positive	Prevalence (%)	Number Positive	Prevalence (%)	Number Positive	Prevalence (%)
Wet	41	34	82.9%	27	65.81%	37	90.24%
Dry	196	142	72.45%	142	72.45%	163	83.16%
Overall	237	176	74.3%	169	71.31%	200	84.4%

Chi-sq=1.3, p=0.256, degrees of freedom=1, thus, there was no significant difference ($p>0.05$) in *H. contortus* and *T. axei* between sheep and goats

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Table 4: The worm burden of *H. contortus* and *T. axei* in sheep and goats based on species

Nematode Species	Animal Species	Number Positive	Mean	SEM	Std. Deviation	95% CI for Mean		ANOVA	
						Lower	Upper	F	**Sig.**
Hemonchus contortus	Sheep	100	168	18	199	132	203	0.067	0.795*
	Goat	76	160	23	243	114	205		
	Total	176	164	14	220	136	192		
Trichostrongylus axei	Sheep	99	145	17	190	111	179	1.519	0.219*
	Goat	70	116	16	171	84	148		
	Total	169	131	11	182	108	154		
Total Adult Worms	Sheep	113	313	28	323	256	370	0.71	0.400
	Goat	87	277	31	331	215	339		
	Total	200	296	21	327	254	338		

*p=0.795, 0.219, thus, there was no significant difference (p>0.05) in *H. contortus* and *T. axei* burden between sheep and goats

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Table 5: The worm burden of *H. contortus* and *T. axei* in sheep and goats based on sex

Nematode Species	Sex	Number Positive	Mean	SEM	Std. Deviation	95% CI for Mean		ANOVA	
						Lower	Upper	F	Sig*.
Haemonchus contortus	Male	167	164	14	223	134	193	0.011	0.915
	Female	9	170	45	162	72	268		
	Total	176	164	14	220	136	192		
Trichostrongylus axei	Male	162	130	12	182	106	154	0.152	0.697
	Female	7	150	50	183	40	261		
	Total	169	131	11	182	108	154		
Total Adult Worms	Male	190	294	21	327	251	337	0.081	0.776
	Female	10	321	90	327	123	519		
	Total	200	296	21	326	254	338		

*There was no significant difference (p>0.05) in *H. contortus* and *T. axei* burden between both male and female sheep and goats

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Table 6: The seasonal worm burden of *H. contortus*and *T. axei* in sheep and goats around Hawassa town

Nematode Species	Seasons	Number Positive	Mean	SEM	Std. Deviation	95% CI for Mean		ANOVA	
						Lower	Upper	F	Sig.
Haemonchuscontortus	Wet	34	134	21	138	91	178		
	Dry	142	170	16	234	137	203	0.885	0.348
	Total	176	164	14	220	136	192		
Trichostrongylusaxei	Wet	27	70	12	81	44	96		
	Dry	142	144	13	194	116	171	5.677	0.018
	Total	169	131	11	182	108	154		
Total Adult Worms	Wet	37	205	28	182	147	263		
	Dry	163	315	24	346	266	364	3.885	0.048*
	Total	200	296	21	326	254	338		

*p=0.048, thus, there was significant difference in *H. contortus* and *T. axei* burden in sheep and goats between dry and wet seasons

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