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SURVEILLANCE OF BLOOD PARASITES OF NATURALLY-GROWN SMALL RUMINANTS IN SELECTED PROVINCE OF REGION 02

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ABSTRACT

This study aimed to determine the epidemiology and surveillance of blood parasites of naturally-grown small ruminants in selected province of Region 02. Descriptive method through a survey questionnaire and a blood parasite examination was employed. Survey showed that, there were 23 naturally-grown small ruminant farms located at Districts II and III in Cagayan province. *Anaplasma* spp. and *Babesia* spp. were the species of blood parasite identified. Test of difference showed that presence of blood parasites was significant with sex of the naturally-grown small ruminants and between Districts. Further, test of relationship showed that types of housing, fence, floor, breeding, and feeding system were significant of the naturally - grown small ruminant farms. Thus, it concludes that the type of management practiced by the farmers results in the present of blood parasite.

Keywords: blood parasites, management practices, naturally-grown small ruminants

I. INTRODUCTION

Animal health surveillance is an assessment tool to monitor disease occurrence and trends, to facilitate prevention and control of disease, to provide data for use in risk analysis, for animal or public health purposes (Terrestial Animal health Code, 2019). Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. Healthy is free from disease or pain. Thus, a healthy animal has a normal appearance, behaviour, features, body position and movements.

The province of Cagayan has abundant natural resources and is rich in agriculture. Agriculture remains the dominant activity throughout the province which includes rice grain, corn, tobacco, livestock, and poultry industry. Agricultural activities specifically livestock production add stability to farm incomes and food security in the province.

Small ruminant livestock like sheep and goats are among the major economically important livestock in the province. This provides a vast range of products such as meat, milk, skin, horns, bones, and manure. Aside from a source of protein, small ruminants provide services like cash, security, gifts, religious rituals and medicine for the small ruminant raisers in the province.

However, livestock diseases can greatly affect animal production, productivity, and trade. Because of the increasing scale of small ruminant livestock raising in the rural areas, emerging problems are inevitable that become a threat not only to the animals but also to livestock raisers. One of the emerging concerns in the livestock industry especially in ruminants is the occurrence of parasitism. The Department of Agriculture Regional Field Office 2, Regional Animal Disease Diagnostic Laboratory (DA RFO2 – RADDL) summarized parasitology laboratory results which showed the percentage of positive fecal samples from 2016 (84.80%) to 2017 (51.85%) and then 2018 (67.25%). Also, blood parasitism or blood parasite infections cause significant economic losses in livestock (Cheah *et al*. 1994; Tilak 2013). The infection is characterized by anemia, emaciation, jaundice and in severe cases, mortality.

Blood parasite infections in ruminants are primarily caused by the protozoans such as *Babesia* spp., *Trypanosoma* spp. and *Theleria* spp. and rickettsia such as *Anaplasma* spp. (Tilak 2013; Rohaya *et al*. 2017). These protozoans and rickettsia are transmitted by arthropod vectors such as ticks, flies, mites, lice, and fleas (Levine 1985; Wall and Shearer 2001; Rohaya *et al*. 2017; Galay *et al*. 2018 and Cruz 2018). With this, good farm management is vital factor to consider in the health status on animal. Animal welfare is viewed as an integral part of an overall 'food quality concept'.

Thus, this study aimed to identify and report the blood parasites affecting naturally-grown ruminants in the three districts of Cagayan. The result of the study could greatly improve the quality of life for farm animals as well as often improving productivity and product quality and thereby generating economic benefits for the farmers.

II. METHODOLOGY

Description of the surveyed area and sampling

Livestock Section of the Department of Agriculture Regional Field Office 02 showed that in the 2016 records, there were a total of 127 registered small ruminant farms in the province of Cagayan. A descriptive survey was carried out for small ruminant farms in the three Districts of the province of Cagayan. From the list of registered small ruminant farms, only operational farms were surveyed for naturally-grown ruminant population through a formulated survey instrument composed of the farmer's profile, farm profile, and farm management composed of housing management, feed management, watering management, breeding management, and herd health management.

Blood collection, staining, and examination

In the study, the sheep and goats were restrained properly, and blood samples each measuring three (3) milliliters of whole blood in EDTA (lavender top) were taken from jugular vein. For venipuncture, the handler restrained the animal with one arm around its neck. The site for venipuncture was cleansed with 70% alcohol, then digital pressure was applied on the jugular vein with the use of 2 gauge 3.75 needle attached to 3ml syringe, then blood was drawn from the vein. The collected sheep and goat blood samples were taken to Microbiology Laboratory of Cagayan State University, Carig Campus for blood film/ smear preparation, staining and examination. Blood parasite examination (BPE) or Hemoparasite examination of the Romanowsky stained blood smears was done using immersion microscopy (1000x). The stained blood smears showing positive diagnoses during the examination for *Babesia* spp. revealed presence of single pyriform bodies inside the RBCs, and *Anaplasma* spp. appeared as dense, homogenously staining blue purple inclusions at the center or margin. Stained blood smears that were positive for blood parasites were recorded and documented.

Ethical considerations

Prior to the conduct of the study, approved request letters were sought from the Office of the Regional Director of the Department of Agriculture, Office of the Municipal Mayors, Municipal Agriculturist and Municipal Veterinarians. The procedures on animals in this study have been approved by the Institutional Animal Care and Use Committee of CSU and with the approval of the farm veterinarians, technicians, and proprietor of the small ruminant farms to ensure that proper care and no animals were harmed.

Data Analysis

The data collected were used to correlate the presence of the blood parasite as to age, sex, and district of the small ruminants and determine the management practices of the small ruminant raisers in the different municipalities of Cagayan province. Data were analyzed using Chi-Square test to associate parasitism to age, sex and district of the small ruminants. Statistical calculations were performed using Microsoft Excel. $P<0.05$ was considered significant.

III. RESULTS AND DISCUSSIONS

Table 1 presents the number of small ruminant farms in the three Districts of Cagayan. Out of the 127 registered farms in the 2016 records of the Livestock Section of the Department of Agriculture Regional Field Office 02, results showed that there were 47 operational farms at the time of study wherein 23 were naturally-grown farms surveyed. The study revealed that most of the naturally-grown small ruminant farms were located at District III (78.26%), followed by District II (21.74%) and no naturally-grown small ruminant farms were located at District I.

Table 1. Number of registered, operational and naturally-grown small ruminant farms in the three Districts of Cagayan.

DISTRICT	NUMBER OF SMALL RUMINANT FARMS		
	Registered (2016)	Operational (2018)	Naturally-Grown
I	35	16	0
II	23	11	5
III	69	20	18
Total	**127**	**47**	**23**

Table 2 presents the herds of goats and sheep in the three Districts of Cagayan. Results showed that there were more goats raised than sheep in the province. Among the 3 Districts, there were 2 Districts with naturally-grown small ruminant farms, namely; District III with 305 (83.79%) small ruminants and District II with 59 (16.21%) small ruminants, while District I does not have naturally-grown small ruminant farms.

Records showed that in the surveyed naturally-grown small ruminants in the two Districts, there were more goats (58.24%) than sheep (41.75%) reared by the raisers. Possible reasons for these results were the similar reports of Hosseini *et al*. (2018) and Devendra and Liang (2012) that Asia is the home of the goat because the region hosts 60% of the 1 billion world goat population and has been claimed that domestication of wild goats began in Asia more than 100 centuries ago. Goats in Asia are reared by small-scale farmers, who raised goats for nutrition, food security, and socio-economic status.

Table 3 shows the blood parasites identified between goats and sheep in the naturally - grown small ruminant farms in the three Districts of Cagayan. Results showed that there were two (2) species of blood parasites identified

namely: *Anaplasma* spp. (Fig. 1) and *Babesia* spp. (Fig. 2). Previous studies mentioned that blood parasite infections in ruminants are primarily caused by the protozoans such as *Babesia* spp., *Trypanosoma* spp. and *Theleria* spp.) and rickettsia such as *Anaplasma* spp. (Tilak 2013; Rohaya *et al*. 2017).

Table 2. Herds of goats and sheep reared in the small ruminant farms in the three Districts of Cagayan.

DISTRICT	NUMBER OF FLOCKS					
	Operational Farms		Total	Naturally-Grown Farms		Total
	Goats	Sheep		Goats	Sheep	
I	229	85	**314**	0	0	**0**
II	140	209	**349**	49	10	**59**
III	199	149	**348**	163	142	**305**
Total	**568**	**443**	**1011**	**212**	**152**	**364**

Result also showed that District II demonstrated more blood parasite infection in sheep in comparison with District III wherein there are more blood parasite infection in goats. Presence of more blood parasite in sheep can be explained in the study conducted by Alba-Huratdo and Munoz-Guzman (2013).

They emphasized that such resistance is an inheritable genetic trait associated with certain sheep breeds. While a higher infection of goats in District III can be attributed to the animal's susceptibility to parasitism which was supported in the study of Pezzanite *et al*. (2009). They found that goats are generally more susceptible to internal parasites than sheep. The presence of external parasites (Fig. 3) like ticks, flies were noted in the naturally-grown small ruminant farms.

Table 3. Blood parasites identified between goats and sheep in naturally-grown farms in the three Districts of Cagayan.

BLOOD PARASITES IDENTIFIED	DISTRICT I			DISTRICT II			DISTRICT III			GRAND TOTAL
	Goat	Sheep	Total	Goat	Sheep	Total	Goat	Sheep	Total	
Anaplasma spp.	0	0	**0**	5	8	**13**	48	3	**51**	**64**
Babesia spp.	0	0	**0**	0	0	**0**	54	57	**111**	**111**
Total	**0**	**0**	**0**	**5**	**8**	**13**	**102**	**60**	**162**	**175**

The presence of these external parasites may serve as a vector for blood parasites like *Anaplasma* and *Babesia* (Rohaya *et al*. 2017; Galay *et al*. 2018; Cruz 2018).

Statistical analysis showed no significant difference on the determined parasites between goats and sheep (Chi-square test = 3.04, P value = 0.0812).

However, results showed that the presence of blood parasites differ significantly between Districts (Districts II and III) (Chi-square test = 24.36, P value = 0.0000). This means that there was a significantly higher percentage of the presence of blood parasites in naturally-grown small ruminants in District III than in District II.

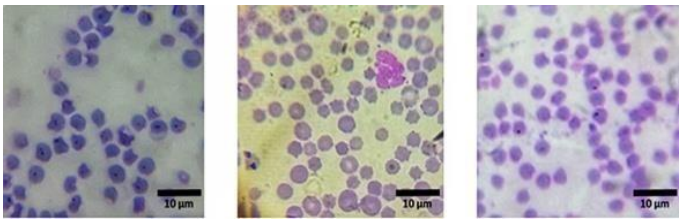

Figure 1. *Anaplasma* spp.

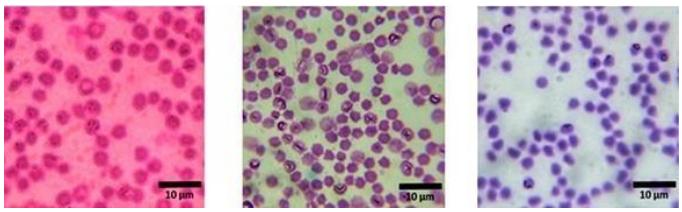

Figure 2. *Babesia* spp.

Figure 3. External parasites.(a and b)ticks; (c) housefly; and (d) host (dog) of external parasites drinking in the waterer of the small ruminants.

Table 4 shows the age range of small ruminants positive for blood parasite in the naturally - grown farms in the three Districts of Cagayan. Adult small ruminants which were more than 8 months old (81.59%) found to be more infected with blood parasites as compared to young small ruminants which were less than 8 months old (18.41%). Result of this study corresponds with the previous study of Tilak *et al*. (2013) wherein older animals were more infected with *Anaplasma* and *Babesia* than younger ones; however, the study of Pezzanite *et al*. (2009) contradicted the result of the present study when he found that the groups most susceptible to parasitism are young animals.

Statistical analysis showed no significant association of age range in naturally-grown small ruminants and the presence

of blood parasites (Chi-square test =1.4708, P value = 0.22522). This means that blood parasites may occur at any age range of naturally-grown small ruminants. Also, the presence of the blood parasites does not vary across the different Districts of Cagayan (Districts II and III) (Chi-square test =2.7894, P value = 0.09489).

Table 4. Age range of naturally-grown small ruminants examined for blood parasite in the three Districts of Cagayan

AGE RANGE	NUMBER OF SMALL RUMINANTS EXAMINED									GRAND TOTAL
	DISTRICT I			DISTRICT II			DISTRICT III			
	Positive	Negative	Total	Positive	Negative	Total	Positive	Negative	Total	
Young (< 8 months old)	0	0	0	0	8	8	29	7	36	**44**
Adult (> 8 months old)	0	0	0	13	15	28	133	34	167	**195**
TOTAL	**0**	**0**	**0**	**13**	**23**	**36**	**162**	**41**	**203**	**239**

Table 5 shows the sex of small ruminants positive for blood parasite in the naturally-grown farms in the three Districts of Cagayan. Females (73.22%) were more infected than males (26.78%) with blood parasites. Previous studies believed that female animals are more prone to blood parasitism due breeding, calving and milk production as compared to male animals (Pezzanite *et al*. 2009; Ademola and Onyiche 2013; Ukwueze and Kalu 2015). Statistical analysis showed a significant difference or association between the sex of naturally-grown small ruminants and the presence of blood parasites (Chi-square test = 5.124477, P value =0.024). This means that percentage of naturally-grown small ruminants with positive blood parasites significantly differs between male and female ruminants.

Table 5. Sex of naturally-grown small ruminants examined for blood parasite in the three Districts of Cagayan.

SEX	NUMBER OF SMALL RUMINANTS EXAMINED									GRAND TOTAL
	DISTRICT I			DISTRICT II			DISTRICT III			
	Positive	Negative	Total	Positive	Negative	Total	Positive	Negative	Total	
Male	0	0	0	1	9	10	39	15	54	**64**
Female	0	0	0	12	14	26	123	26	149	**175**
TOTAL	**0**	**0**	**0**	**13**	**23**	**36**	**162**	**41**	**203**	**239**

Table 6 presents the type of farm system in naturally-grown farms in the three Districts of Cagayan. Results showed that semi-intensive type of farm system was adapted by 22 (95.65%) small ruminant raisers and 1

(4.35%) small ruminant raiser adapted the extensive type of farm system. Result of the study has similar descriptions with the previous study of Payne (1990) and Wilson (1991), wherein in the semi-intensive farm system, small ruminant raisers allow their animals to graze or browse in the field but not during cropping seasons. During cropping, the small ruminants were kept in houses and fed on cut – and – carry basis with cut grasses. The number of goats and sheep kept is usually small (not less than 10) and in extensive farm system. The small ruminants were allowed to graze or browse on large areas of land that were not suitable for agricultural use. The number of goats and sheep kept is usually small (50 - 200). Also, stated in the studies by Urdaz-Rodriguez *et al*. (2009), Sajid *et al*. (2014), Sharma *et al*. (2015), and David (2018) that good farm management is an essential factor to consider in the health status of animals, wherein animals intensively reared and raised in organized farms have lower prevalence of parasitism as compared to semi-intensive and extensive systems. Statistical analysis showed no significant difference between the type of farm system adapted by the naturally-grown small ruminant raisers in the two Districts (Districts II and III) (Chi-square test = 3.76, P value = 0.0524).

Table 6. Naturally-grown small ruminant farms based on types of farm system in the three Districts of Cagayan.

	DISTRICT I	DISTRICT II	DISTRICT III	TOTAL
Farm System				
Semi-Intensive	0	4	18	**22**
Extensive	0	1	0	**1**
Total	**0**	**5**	**18**	**23**

Table 7 shows the housing management of naturally-grown small ruminant farms in the three Districts of Cagayan. Based on types of housing, over pole (69.57%) (Fig. 4) was preferred than over ground (30.43%); on house orientation, east – west (78.26%) (Fig. 5) was more common than north – south (21.74%); on type of floor, wood (47.83%) (Fig. 6) was preferred followed by soil/dirt (34.78%) than concrete (17.39%); on type of roof and fence, the galvanized roof (100%) (Fig. 7) and hog wire (82.61%) (Fig. 8) were mostly used and preferred by the small ruminant raisers. Results obtained can be further explained by Adu *et al*. (1986) that specific housing design is suitable for production purpose, and that proper housing and management of animal facilities like house, roof, floor and fence are essential to animal health and well-being; the shelter and housing type vary according to climate, geographical region, season, production system and personal preference of the raiser. Statistical analysis showed no significant association based on the type of housing of the naturally-grown small ruminant farms from the 2 Districts (Districts II and III) (Chi-square test = 0.28, P value = 0.5993), also no significant association based on house orientation (Chi-square test =1.77, P value = 0.1828), and no significant association on type of house roof (Chi-square test =0.00, P value = 1.0000). However, there was a significant association based on the type of fence used for the naturally-grown small ruminant farms in the 2 Districts (Districts II and III) (Chi-square test = 17.43, P value = 0.00063.76), and a significant association with the type of floor (Chi-square test = 6.10, P value = 0.0473) used.

Table 7. Naturally-grown small ruminant farms based on types of housing management in the three Districts of Cagayan.

	DISTRICT I	DISTRICT II	DISTRICT III	TOTAL
Type of Housing				
Over ground	0	2	5	**7**
Over pole	0	3	13	**16**
TOTAL	**0**	**5**	**18**	**23**
Orientation				
East to West	0	5	13	**18**
North to South	0	0	5	**5**
TOTAL	**0**	**5**	**18**	**23**
Type of Floor				
Wood	0	0	11	**11**
Soil/Dirt	0	3	5	**8**
Concrete	0	2	2	**4**
TOTAL	**0**	**5**	**18**	**23**
Type of Roof				
Galvanized	0	5	18	**23**
Non-galvanized	0	0	0	**0**
TOTAL	**0**	**5**	**18**	**23**
Type of Fence				
Barb Wire	0	1	0	**1**
Hog Wire	0	1	18	**19**
Concrete	0	2	0	**2**
None	0	1	0	**1**
TOTAL	**0**	**5**	**18**	**23**

Figure 4. Housing management: Over pole type of housing; East – west house orientation; and Galvanized house roofing.

Table 8 shows the feeding management practiced by the small ruminant raisers in naturally - grown small ruminant farms in the three Districts of Cagayan. Results showed that in the feeding system, free range (91.30%) (Fig. 7) was preferred by the small ruminant raisers compared to cut and carry (0.00%) or combination of cut and carry or free range (8.70%). In the type of feed, all small ruminant raisers feed their animals with grass (100.00%) (Fig. 6) like Napier or elephant grass (*Pennisetum purpureum* Schum.),

and in giving of feed supplements, all small ruminant raisers do not practice giving supplements (100.00%) in the nutrition of their animals.

Figure 5. Housing management: Wood type of floor.

Figure 6. Housing management: Hog wire type of fence.

Nutritional management of sheep and goats involves the management of amount and quality of forage resource and plant species present. Similar with the study of Venereo and Hermosillo (2014) stating that the most important production system for rearing small ruminants in the majority of the islands is still the free ranging wherein the animals are let loose in the mornings and spend the day roaming around looking for feed and water. In his paper, Rusdy (2016) mentioned that napier or elephant grass (*Pennisetum purpureum* Schum.) has a great potential to alleviate the problem of feeds in the tropics for small ruminants because it is drought resistant, has high dry matter yield potential, and its chemical composition and nutritive value are related to animal's management and requirement. Statistical analysis showed that, based on the feeding system there was a significant association on the naturally-grown small ruminant farms in the 2 Districts (Districts II and III) (Chi-square test = 7.89, P value = 0.0194). However, there was no significant association based on the type of feed (Chi-square test = 0.00, P value =1.0000) and feed supplements (Chi-square test = 0.00, P value = 1.0000).

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Table 8. Naturally-grown small ruminant farms based on types of feeding management in the three Districts of Cagayan.

	DISTRICT I	DISTRICT II	DISTRICT III	TOTAL
Feeding System				
Free Range	0	3	18	**21**
Cut and Carry	0	0	0	**0**
Free Range/Cut and Carry	0	2	0	**2**
TOTAL	**0**	**5**	**18**	**23**
Type of feed				
Commercial Feeds	0	0	0	**0**
Grass	0	5	18	**23**
TOTAL	**0**	**5**	**18**	**23**
Feed Supplements				
With Supplements	0	0	0	**0**
Without Supplements	0	5	18	**23**
TOTAL	**0**	**5**	**18**	**23**


Figure 7. Feeding management: Free range type of feeding.


Figure 8. Feeding management: Grasses fed to naturally-grown small ruminants

Table 9 shows the water management practiced by the small ruminant raisers in naturally - grown small ruminant farms in the three Districts of Cagayan. Results showed that there were 8 possible sources of water in the small ruminant farms. The tap water (60.86%) (Fig. 9) was the most common among all. Further, all small ruminant farms do not practice giving water additive (100.00%) in the nutrition of their animals. The study conducted by Meehan *et al.* (2015) stressed that it is better if water for sheep and goats originates from public water system, that potentially provides same quality as drinking water for human consumption.

Statistical analysis showed no significant association of the naturally-grown small ruminant farms based on types of water management in the two Districts (Districts II and III). This means that the naturally-grown small ruminants from the two Districts were not associated nor dependent from the source of water (Chi-square test = 9.15, P value = 0.2424) and water additives (Chi-square test =0.00, P value =1.0000).

Table 9. Naturally-grown small ruminant farms based on types of water management in the three Districts of Cagayan.

	DISTRICT I	DISTRICT II	DISTRICT III	TOTAL
Source of Water				
Local Well	0	0	5	**5**
Pump Well	0	1	0	**1**
Borehole	0	0	0	**0**
Tap Water	0	3	11	**14**
Lake/River	0	0	1	**1**
Local Well/Borehole	0	1	0	**1**
Local Well/Tap Water	0	0	1	**1**
Tap Water/Lake	0	0	0	**0**
TOTAL	**0**	**5**	**18**	**23**
Water Additives				
With Additives	0	0	0	**0**
Without Additives	0	5	18	**23**
TOTAL	**0**	**5**	**18**	**23**


Figure 9. Water management: Tap water as the most common source of water.

Table 10 shows the breeding management practiced by the small ruminant raisers in naturally-grown small ruminant farms in the three Districts of Cagayan. Results showed that inbreeding (73.91%) was mostly practiced by the small ruminant raisers as compared to crossbreeding (17.39%) and combination of crossbreeding and inbreeding (8.70%). Vogt *et al.* (1993) in their study mentioned that the reason for inbreeding is the development of highly productive inbred lines of domestic livestock. They further mentioned that inbreeding is essential to the development of prepotent animals — animals that uniformly "stamp" their characteristics on their progeny. Because inbreeding causes an increase in the proportion of like genes (good or bad, recessive or dominant), the inbred animal's reproductive cells will be more uniform in their genetic makeup. When this uniformity involves a relatively large number of dominant genes, the progeny of that individual will uniformly display the dominant characteristics of that parent.

Statistical analysis showed that there is a significant association as revealed by the P-value 0.0164, showing that naturally-grown small ruminant farms from the two Districts (Districts II and III) were associated with the type of breeding used.

Table 10. Naturally-grown small ruminant farms based on types of breeding management in the three Districts of Cagayan.

	DISTRICT I	DISTRICT II	DISTRICT III	TOTAL
Type of Breeding				
Crossbreeding	0	3	1	**4**
Inbreeding	0	2	15	**17**
Crossbreeding and Inbreeding	0	0	2	**2**
TOTAL	**0**	**5**	**18**	**23**

Table 11 shows the herd health management practiced by the small ruminant raisers in naturally-grown small ruminant farms in the three Districts of Cagayan. Results showed that majority of the small ruminant raisers do not give preventive measures or prophylaxis (100.00%), deworming (100.00%), treatment (100.00%), and pest control program (100.002%) in their farms. Naturally-grown small ruminants as defined and described are goats and sheep raised without preventive/prophylactic measures, no treatment given, and no pest control program in the farm's herd health management. In the study of Iqbal *et.al*. (2011), it was stressed that the absence of veterinary services which is a very important part of farm management like vaccination or prophylactic measures, deworming and pest control treatment will contribute to hemoparasite infection. This could also be the reason why in the present study, there is a positive result of blood parasitism in the farms. Statistical analysis showed no significant association of naturally-grown small ruminant farms on the two Districts (Districts II and III) based on prophylaxis, deworming, treatment, and pest control (Chi-square test =0.00, P value =1.0000).

Table 11. Naturally-grown small ruminant farms based on herd health management in the three Districts of Cagayan**.**

	DISTRICT I	DISTRICT II	DISTRICT III	TOTAL
Prophylaxis				
With Vaccination	0	0	0	**0**
Without Vaccination	0	5	18	**23**
TOTAL	**0**	**5**	**18**	**23**
Deworming				
With Deworming	0	0	0	**0**
Without Deworming	0	5	18	**23**
TOTAL	**0**	**5**	**18**	**23**
Treatment				
With Treatment	0	0	0	**0**
Without Treatment	0	5	18	**23**
TOTAL	**0**	**5**	**18**	**23**
Pest Control				
With Pest Control	0	0	0	**0**
Without Pest Control	0	5	18	**23**
TOTAL	**0**	**5**	**18**	**23**

SUMMARY AND CONCLUSION

The study showed that, twenty (23) naturally grown ruminant farms were surveyed mostly at Districts II and III in Cagayan Valley. *Anaplasma* spp. and *Babesia* spp. were the two species of blood parasite identified in the small ruminants. The farms adapted more the semi-intensive type of farm system. On housing management, they preferred over pole types, east-west house orientation, wood flowing, galvanized roof, and hog wire type of fence. On feeding management, they preferred free range feeding system, chose grass like Napier *(Pennisetum purpurean* Schum.*)*, and never practice giving supplements. On water management, the tap water was the most common source, and they never practiced giving water additive. On breeding management, inbreeding was mostly practiced. On herd health management, most of them did not give preventive measures, deworming, treatment, and pest control program. Test of difference showed that the presence of blood parasites was found significant with the sex of the naturally-grown small ruminants and between districts. Also, test of relationship showed that types of housing, fence, floor, breeding, and feed system were found significant of the naturally-grown ruminant farms. Thus, it concludes that the type of management practiced by the farmers results in the present of blood parasite. That types of housing fence, floor, breeding and feeding systems are essential factors and found significant in the health status of animal. Sex and district are contributory factors and found significant in terms of the presence of blood parasites. Females are more prone to blood parasitism, while District III has a higher percentage of the presence of blood parasites in naturally grown small ruminants.

Thus, the study implies that good management practices are vital in preventing parasitism in the farms. This may lead to a sustainable and profitable small ruminant production systems. With this, a multidisciplinary approach is considered to come up with nutritional strategies that would make ruminants more resilient to the environmental and physiological challenges which eventually increase farm profitability. Also, it is recommended that a similar study in the other provinces of Region 02 will be performed and that the use of molecular techniques as an additional tool in the identification of blood parasites will be done.

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REFERENCES

[1] Ademola Io, Onyiche Te. 2013. Haemoparasites and haematological parameters of slaughtered Ruminants and pigs at Bodija Abattoir, Ibadan, Nigeria. *African Journal of Biomedical Research*. 16:101-105.

[2] Adu If, Ngere Lo. 1979. The indigenous sheep of Nigeria. *World Review of Animal Production*, 15(3): 51-62.

[3] Alba-Hurtado F. and Munoz-Guzman Ma. 2013. Immune Responses Associated with Resistance to Haemonchosis in Sheep. *BioMed Research International*. 2013(162158):2-11

[4] Cheah TS, Sani RA, Chandrawathani P, Sansul B and Dahlan I. 1999. Epidemiology of *T. evansi* infection in crossbred dairy cattle in Malaysia. *Tropical Animal Health & Production*. 31:25-31.

[5] Cruz K. B. 2018. Detection of Pathogens on the Brown Dog tick, *Rhiphicephalus sanguineus* sensu lato (s.l.) (Arachnida: Acari: Ixodidae) in the Philippines. *Philippine Journal of Science*. 147 (4): 741-751.

[6] David S, Ola-Fadunsin & Gimba, Fufa & Abed, Donea & Sunil Kumar Sharma, Reuben & Jesse A, Faez Firdaus & Abdullah Sani,Rehana. 2018. Epidemiology and risk factors associated with Anaplasma marginale infection of cattle in Peninsular Malaysia. *Parasitology International*. 67: 659-665.

[6] Devendra C, Liang JB. 2012. Conference summary of dairy goats in Asia: current status, multifunctional contribution to food security and potential improvements. *Journal of Small Ruminant Research.* 108:1–11. https://doi. org/ 10.1016/j.smallrumres.2012.08.012

[7] Galay RL, Manalo AAL, Dolores SLD, Aguilar IPM, Sandalo Kac, Cruz KB, Divina BP, Andoh M, Masatani T, Tanaka T. 2018. Parasites & Vectors. Molecular detection of tick-borne pathogens in canine population and *Rhipicephalus sanguineus* (sensu lato) ticks from southern Metro Manila and Laguna, Philippines. Parasites and Vectors. 11(643): 1-8.

[8] Gonzales, AT[1], Pattung, B[2], and Sawadan, R[2] (2020). Growth and economic potential of newly estab- lished Cacao (Theobrama cacao) plantation intercropped with glutinous Corn (Zea mays) and Mungbean (Vigna radiata L.).Journal of Biodiversity and Environmental Sciences . 16 (5) 39-45.

[10] Gonzales, AT[1], Pattung, J[2], and Sawadan, R (2020). Hydroponically grown lettuce (Lactuca satica) varieties using Simple Nutrient Addition Program (SNAP) hydroponic technology for enterprise development. Journal of Biodiversity and Environmental Sciences. 16 (5) 52-56

[11] Gonzales, A. T. & Isnec M.(2019).Morphological characterization of four peanut (*Arachis hypogaea* L.) varieties under Lal-lo, Cagayan condition: Its phenotypic changes to type II climate of the Philippines. International Journal of Biosciences. 14 (6) 399-406.

[12] Gonzales, A. T. & Isnec M.(2019).Agronomic and economic performance of four peanut (*Arachis hypogaea* L.) varieties under Lal-lo, Cagayan, Philippines. International Journal of Bio sciences. 14 (6), 376 -382.

[13] Gonzales, A.T.,Sawadan R. , Flores, A. (2018).Cacao Mapping Using Geographic Information System (GIS) in the Province of Cagayan. Journal of Biodiversity and Environmental Sciences

[14] Gonzales, A.T. (2018). Influence Of Alpha-Naphthalene Acetic Acid (ANAA) On *Lubeg (Syzygium spp.)* Marcots. Journal of Biodiversity and Environmental Sciences (JBES). 12 (5) 284-292.

[15] Gonzales, A. T, (2018). Antifungal properties of indigenous phytoextracts against *Fusarium* spp. causing root rot in mulberry(Morus spp). Journal of Biodiversity and Environmental Sciences. 12 (5)204-210

[16] Hosseini SM, Kalantar M. Country report for Iran. In: Proceedings of The 4th International Asian-Australasian Dairy Goat Conference; 2018 Oct 17–19; Tra Vinh, Vietnam. p. 77–81.

[17] Iqbal F, Fatima M, Shahnawaz S, Naeem M, Shaikh Rs, Ali M, Shaikh As, Aktas M. 2011. A study on the determination of risk factors associated with babesiosis and prevalence of Babesia sp., by PCR amplification, in small ruminants from Southern Punjab (Pakistan). Parasite. 18(3):229-234.

[18] Levine ND. 1985. *Veterinary Protozoology*. Iowa State University Press, Ames.

[19] Meehan Ma, Stokka G, Mostrum M. 2015. Livestock Water Requirements. NDSU Extension service, AS1763, https://www.ag.ndsu.edu/pubs/ansci/livestoc/as1763.pdf, accessed 23.04.2017

[20] Pattung B., Gonzales A T, Isnec, M. D. (2020). Growth and yield performance of cassava (Manihot esculenta) intercropped with leguminous crops. Journal of Biodiversity and Environmental Sciences. 16 (5) 46-51.

[21] Payne Wja. 1990. *An Introduction to Animal Husbandry in the Tropics*, 4th ed. Tropical Agriculture Series. Longman. New York. pp. 881.

[22] Pezzanite L, Neary M, Hutchens T, Scharko P. 2009. *Common Diseases and Health Problems in Sheep and Goats*. Purdue Extension. 1-12.

[23] Rohaya MA, Tuba Thabitah AT, Kasmah S, Azzura L, Chandrawathani P, Saipul Bahari AR. 2017. Common

blood parasites diagnosed in ruminants from 2011 to 2015 at the Central Veterinary Laboratory, Sepang, Malaysia. *Malaysian Journal of Veterinary Research*. 8(1):163-167.

[24] Rusdy M. 2016. Elephant grass as forage for ruminant animals. *Livestock Research for Rural Development*. Volume 28, Article #49. Retrieved May 17, 2020, from http://www.lrrd.org/lrrd28/4/rusd28049.html

[25] Sajid MS, Siddique RM, Khan SA, Iqbal Z and Khan MN. 2014. Prevalence and risk factors of anaplasmosis in cattle and buffalo populations of district Khanewal, Punjab, Pakistan. *Global Veterinaria*. 12 (1):146–153.

[26] Sharma A, Singla LD, Tuli A, Kaur P and Singh Bal M. 2015. Detection and assessment of risk factors associated with natural concurrent infection of *Trypanosoma evansi* and *Anaplasma marginale* in dairy animals by duplex PCR in eastern Punjab. *Tropical Animal Health and Production*. 47:251–257.

[27] Tilak CN, Jamal UB, ShafiuL A. 2013. A Study on the Prevalence of Common Blood Parasites of Cattle in Sylhet District of Bangladesh. *International Journal of Animal & Fisheries Science*. 1(1): 8-13.

[28] Ukwueze CS, Kalu EJ. 2015. Prevalence of haemoparasites in red sokoto goats slaughtered at Ahiaeke Market, Umuahia, Abia State, Nigeria. *Journal of Veterinary Advances*. 5 (2): 826-830.

[29] Urdaz-Rodriguez JH, Fosgate GT, Alleman AR, Raed O, Donvan GA and Melendez P. 2009. Seroprevalence estimation and management factors associated with high herd seropositivity for *Anaplasma marginale* In commercial dairy farms of Puerto Rico. *Tropical Animal Health and Production*. 41:1439-1448.

[30] Venereo IH, Hermosillo MDS. 2014. Small ruminant management and feeding with high quality forages in the Caribbean. © Interamerican Institute of Cooperation In Agriculture. Santo Domingo, Dominican Republic.

[31] Vogt D, Swartz Ha, Massey J. © 1993 to 2020. University of Missouri Extension. https:// extension 2. missouri .edu/g2911

[32] Wall R. and Shearer, D. 2001. *Veterinary Ectoparasites: Biology, Pathology and Control*. *Blackwell Science*. pp. 75-76.

[33] Wilson RT. 1991. Small ruminant production and the small ruminant genetic resource in tropical Africa. *FAO Animal Production and Health Paper*. pp. 194.

[35] 2019 © OIE - Terrestrial Animal Health Code - 28 /06/2019. Retrieved from https:// www. oie.int /fileadmin /Home/eng/Health_standards/tahc/current/chapitre _surveillance_general.pdf.