THE ROLE OF DONKEYS IN INCOME GENERATION AND THE IMPACT OF ENDOPARASITES ON THEIR PERFORMANCE

Tamador E.E. Angara[*]; Ahmed A. Ismail[**]; Abdalla M. Ibrahim[***]

* College of Animal Production and Technology, Sudan University of Science and Technology, –SUST Khartoum, Sudan.
** College of Veterinary Medicine, –SUST , Khartoum, Sudan.
***College of Veterinary Science – University of Bahri, Khartoum, Sudan.

االمستخلص

تستخدم الحمير فى السودان لاغراض شتى. يمثل ادرار الدخل فى ولاية الخرطوم أهم هذه الاغراض. لقد تم اجراء دراسات عدة ذات صلة بالحمير بولاية الخرطوم الا أن دور الحمير فى ادرار الدخل وعلاقتها بالنواحى المرضية والفسيولوجية لم يلق حظاً من البحث . هدفت هذه الدراسة الى معرفة دور الحمير فى ادرار الدخل وتأثير الطفيليات الداخلية على ادراره بالاضافة الى معرفة علاقة الطفيليات الداخلية والدخل اليومى ببعض القياسات. استخدمت عينة مكونة من 203 وحدة لجمع بيانات الدخل والتعرف على الطفيليات التى تصيب الحمير وبعض القياسات. توصلت الدراسة الى أن متوسط الدخل اليومى بلغ (15.0±20.00) جنيه سودانى وأن مبلغ 15 جنيه هو الدخل الغالب في اليوم . وجد أن هناك علاقة عكسية ذات دلالة احصائية بين الاصابة بديدان المعدة والامعاء والدخل اليومى. وعلاقة ذات دلالة احصائية بين الدخل اليومى واستخدام طاردات الديدان،الحالة العامة للجسم، معدل مكداس الدم . وان العلاقة غير ذات دلالة احصائية بين الاصابة بديدان المعدة والامعاء وعمر ،وزن الحيوان، الحالة الصحية والمقدرة على العمل ومعدل مكداس الدم. العلاقة بين طفيليات الدم والدخل اليومى غير ذات دلالة احصائية. توجد علاقة ذات دلالة احصائية بين الاصابة بطفيليات الدم والحالة الصحية والمقدرة على العمل.بينما نجد ان العلاقة غير ذات دلالة احصائية بين طفيليات الدم وعمر ،وزن الحيوان ومعدل المكداس. خلصت الدراسة الى ان لطفيليات المعدة والامعاء تأثير سلبى على الدخل اليومى. و أن لاستخدام طاردات الديدان، المعدل العالى لمكداس الدم والحالة العامة الجيدة اثر ايجابى على ادرار الدخل. وأوصت بزيادة وعى اصحاب الحمير بأهمية استخدام طاردات الديدان.

Abstract

Donkeys in Sudan have been used for different purposes, among which income generation in Khartoum State is the main stay. This Study was conducted to evaluate the role of donkeys in income generation and to examine the impact of endoparasites on the income generation together with the association between endoparasites, daily income and some selected measures. The study revealed that the average daily income was SDG 20.00 ± 15.00 and the most frequent income was SDG 15.00 per day per donkey. There was a significant ($P < 0.05$) negative correlation between the daily income and infection with gastrointestinal parasites. A significant ($P < 0.05$) positive correlation between the daily income and the use of anthelmintics was also revealed. The correlation between the daily income and blood parasites was insignificant($P < 0.05$) . The daily income has a significant ($P < 0.05$) positive correlation with the Body Condition Score (BCS) and The Pack cell Volume (PCV %). The relationship between the daily income and the age, body weight and health status and working ability is insignificant ($P > 0.05$). The study concluded that donkeys play an important role as a mean of income generation in Khartoum state and that gastrointestinal parasites do adversely affect the income generation and recommended rising the awareness of donkeys' owners on the importance of deworming.

Introduction

Sudan possesses a large and diversified animal wealth consisting of domesticated animals and wild life. The domesticated animals are mainly ruminants which accounted to141 million head (MARF, 2009). The donkey population was estimated at 7.5 millions (MARF, 2009). Been located in north east region of Africa, the country was identified as the origin of the Nubian wild ass (Beja-Pereira *et al*., 2004) where it has been domesticated and used for different purposes. The most common role of donkeys is transport, whether riding, pack ,transport, or pulling carts. They may also be used for farm tillage, threshing, raising water and milling. (Starkey and Starkey, 1997). Donkeys are widely distributed throughout Northern Sudan. The official data in Sudan showed an annual increase in donkey population by 3% (MARF, 2009). In Kenya donkeys are found in all ecological zones where they provide transport and draught power. In the Lamu archipelago where there is no motorized transport donkeys are virtually the only available means of pack and riding transport (Mukiria, 2010). In Nigeria the estimated overall mean annual income from the use of donkeys and camels was N 8500 (Hassan and Ibitoye, 1999) and in Makete, Tanzania the total annual benefit generated by donkeys ranged between US$ 55 and US$ 124 per household (Sieber, 2004).

The welfare of working horses, mules and donkeys is usually assessed by the direct observation and the body condition scoring grid (BCS). Vall *et al.,* (2003) used (BCS) for the working donkey in Northern Cameroon on a scale of 1 to 4 (emaciated, thin, average, and good) whereas Pritchard *et al.,* (2005) developed a protocol on a scale of 1-5 (1 = very thin; 5 = very fat) for working horses, mules and donkeys in Afghanistan, Egypt, India, Jordan and Pakistan.

Although donkeys should not be worked until they are three years old when they are physically mature, in Mexico, they are often worked earlier than that (de Aluja & Lopez 1991).

The donkeys have often been described as sturdy animals, yet they are subjected to a variety of diseases and usually remain asymptomatic carriers (Kumar *et al.,* 2009). Heavy internal parasitic burden can affect the health of a donkey adversely, (Herd, 1990; *Love et al.,* 1992; Mair, 1994;and Krecek and Gouthrie, 1999). In many African countries helminthes being an important constraint to growth and productivity (Ayele *et al.,* 2006, Saul *et al.,* 1997, Githiori *et al.,* 1998). According to Seri *et al.,* (2004) intestinal nematods in Khartoum State, Sudan accounted to 70.1% of the infections. Blood parasites were reported in many studies e.g, (Kumar *et al.,* 2009; Mekibib *et al.,* 2010; and Balkaya *et al.,* 2010). Piroplasmosis in donkeys caused by *Theileria equi* and *Babesia caballi* has been recognized to affect animals working capacity and manifest loss of appetite (Kumar *et al.,* 2009). Trypanosomiasis and babesiosis are attributed in reduction of donkeys' draughts power and even their survival (Svendsen, 1997).

Ambawat *et al.,* (1999) and Kumar *et al.,* (2002) reported that haemoglobin concentration, red cell counts and PCV levels were reduced significantly in donkeys infected with *B. equi* parasite. Mukiria *et al.,* (2010) reported significant association between trypanosome infection and mean body condition score of the donkeys. The infection was found to be independent of sex and age. However, the mean PCV was significantly associated with age, sex and body condition scores. In another study Mekibib *et al.,* (2010) reported insignificant association between the prevalence of either of the babesia or trypansomes and the age and body condition score. The mean packed cell volume (PCV) in trypanosome infected donkeys was significantly lower than that of non-infected. Conversely, no significant difference was observed between babesia positive and babesia free animals.

Ayele *et al.,* (2006) found that the body condition score and packed cell volume were negatively correlated (r= -0.67 & -0.6, respectively) with the total egg per gram (epg) count.

Although the number of donkeys in Khartoum is declining with urbanization (Rabeh, 2009), yet they are still been used for transport inside and at the outskirts of the three towns with profitable returns. The role of donkeys in income generation in the state needs to be evaluated and to what extent do endoparasitic burden affects income generation?. The present study was conducted to evaluate and answer these questions.

Material and Methods

Study area:

The study was conducted in Khartoum State. The State lies in the semi desert region between the latitude 15. 47′ N and the longitude 32. 43′ E and located at the confluence of the White Nile flowing north from lakeVictoria and the Blue Nile flowing west from Ethiopia. Divided by the Niles, Khartoum is tripartite metropolis with total area of 22.122Km^2 and estimated population of 6.2 in 2009 (Statistical Year Book, 2009). Khartoum State has seen rapid urbanization since 1970s largely as a result of a mass rural-urban migration of a young population, caused by the combined impact of the civil war with the south, desertification and draught in the north. Furthermore, the poverty in the post- conflict environment has manifested itself in difficulty of access to basic needs (food, water, shelter, clothing, health, education and productive jobs). An estimated 2 million informally displaced persons (20%) are found within the state many without jobs and skills.

Study populations:

A total of 203 donkey drawing carts which attended veterinary clinics in 8 administrative units in the three districts of Khartoum were selected using quota sample. Out of these 108 from Omdurman, 54 from Khartoum and 41 from Khartoum North. Data on donkey's age, utiliy, daily income generated and deworming practice were obtained using structured questionnaire. Health status and working ability of donkeys and the body condition were evaluated by the interviewers' observations. Body condition was scored as 1= very thin, 2= thin, 3 = fat and 4 = very fat (Oudman, 2004). Health and working status was scored as 1= ill not working, 2 = ill working and 3 = healthy working. The weights of donkeys were estimated using the following formula based on Miniature Mediterranean Donkey Association (M. M. D. A., 2011) after measuring the required parameters.

$$\text{Weight (Kgs)} = \frac{\text{(Height - Belly height) x Girth x Length}}{3,500}$$
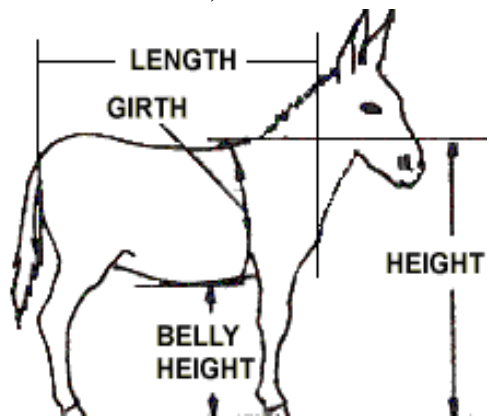

Figure 1: Height, length, girth and belly high of the donkey Source: (M. M. D. A., 2011)

Faecal and blood samples collection:

   (a) Faecal samples collection:

   Faecal materials was taken directly from the rectum and placed in plastic bags, preserved with a drop of 10% buffered formalin.

   (b) Blood samples collection:

   5 ml of blood were withdrawn from the jugular vein using sterile syringes. The blood was immediately transferred to heparinised containers, and placed in cold chest. The faecal and blood samples were then transferred to the Parasitology Lab., College of Veterinary Medicine, Sudan University of Science and Technology for hematological examinations.

Laboratory examination:

   (a) Faecal samples:

   Faeces were gross examined for morphological changes, odour and clour. Thereafter, floatation and sedimentation methods were used to identify and count eggs or larvae of parasitic helminthes (Urquhart *et al.* 1996; Soulsby, 1986). Modified McMaster slide technique was used to count egg per gramme faeces to assess the worm burden. The levels of worm infection were extrapolated from infection severity index defined by Soulsby (1986).

   (b) Blood parasites:

   Thin smear, Geimsa stained slides were examined for blood parasites. Piroplasm, Anaplasma, Trypansomes and Microflariae were the major parasites of interest.

   The anaemic statuses of the donkeys were evaluated using Pack Cell Volume (PCV) and haemoglobin concentration.

Molecular detection, parasite speciation and characterization were also carried out at the Institute of Tropical Medicine (ITM), Antwerp, Belgium.

Data analysis:

The collected data were analyzed using SPSS version 16. Descriptive statistics mainly frequencies, mean, mode and correlation were used.

Results

Utilization of donkeys:

The study revealed that working donkeys in Khartoum State are utilized either as pack or draught animals. About 91.1% of the investigated donkeys were used for pulling carts, while 8.9% were utilized as pack animals. Significant (P<0.05) difference between Khartoum North and Khartoum, Khartoum North and Omdurman were found in the use of donkeys as pack animal was more practiced in Khartoum North. Insignificant difference (P>0.05) between Khartoum and Omdurman was found. The donkey drawn carts, transport of building materials, farm products, and consumer goods. etc (fig 2) They were also used for public transport (fig 3). Pack donkeys, on the other hand were used for distributing milk and transport of light goods and plastic containers (fig 4). Different designs of carts were observed to fulfill above working purposes. Carts with flat surfaces which are used as multipurpose cart. Carts with wooden boxes mainly for bread transport. Special design with two metal barrels attached together was used for water transport and yet another special design for milk containers.

Figure 2: The use of donkeys for transport of consumer goods

Figure 3: The use of donkeys for public transport

Figure 4: The use of donkeys as pack animals

The age of the investigated donkeys:

 The age of the investigated donkeys ranged between 1 to 20 years. The most frequent age fall within the mean of 6.2 years. There was insignificant difference (P >0.05) in the age of the investigated donkeys between the three districts.

The estimated body weight:

The estimated body weight of the investigated donkeys ranged between 101 to 418 Kg with a mean weight of 242.2±224.2 and the most frequent weight was 242 Kg. There was significant difference (p <0.05) in the body weight between the three districts with higher weight in Khartoum district than in the other two ones.

Health status and working ability:

The study revealed that 13.3% of the investigated donkeys were working although they were ill. While 9.3% were ill but not working and those which

were healthy and working accounted for 77.7%. There was insignificant difference (P > 0.05) in the health status and working ability between the three districts.

The body condition:

The body condition of the investigated donkeys varied between very thin to very fat. Most of the investigated donkeys were fat (41.4%) whereas 35.5% were thin and 19.7% were very fat and 3.4% were very thin (emaciated). Significant difference (P <0.05) in the body condition was observed. Khartoum district had a significantly lower body condition score than Omdurman and Khartoum North districts, whereas there was insignificant difference (P >0.05) in the body condition scores between Omdurman and Khartoum North.

Infection with Gastrointestinal Parasites:

As shown in table 1 the microscopic examination revealed that 56.7% the examined donkeys were infected with gastro-intestinal parasites. There was insignificant difference (P> 0.05) in the infection between the three districts.

Table 1: Infection with Gastrointestinal Parasites

infection	Omdurman		Khartoum		Khartoum North		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Not infected	42	39.3	23	42.6	23	55	88	43.3
Infected	66	60.7	31	57.4	18	45	115	56.7
Khartoum State	108	100	54	100	41	100	203	100

 As a management practice about 32.5% of the investigated donkeys were subjected to deworming while 67.5% didn't receive any prophylactic

treatment. There was significant difference (P <0.05) in deworming practice between Khartoum North district and the other two districts with Khartoum North being superior in deworming.

Infection with Blood parasites:

Table (2) shows that the rate of infection with blood parasites was 23.2% and there was insignificant difference between the three districts. The study revealed that there were three types of blood parasites encountered in the investigated donkeys.

Table 2: Infection with Blood parasites

infection	Omdurman		Khartoum		Khartoum North		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Not infected	88	81.2	40	74.1	28	68.3	156	76.8
Infected	20	18.8	14	25.9	13	31.7	47	23.2
Khartoum State	108	100	54	100	41	100	203	100

According to their dominance these were: *Piroplasm* (19%), *Microflaria* (2.6%)   and *Anaplasm* (1.6%) in order and dominance. There was insignificant difference (p>0.05) between the three districts in infection with blood parasites.

The Packed Cell Volume:

The Packed Cell Volume of the donkeys under study ranged between 20 to 44% with a mean value of 31.2±4.3% and the modal value was 31.2%. Insignificant difference (P>0.05) was found between the three districts.

The Daily income generated (SDG) using the investigated donkeys:
The study revealed that there was a wide range in the working hours per day (2-18hr). The average was 8.7 hours. Table (3) presents the daily income generated by working donkeys. It ranged from SDG 4.00 to 80.00 with a mean value of SDG 20.00. The most frequent income was SDG 15.00 per day. This accounted to about (2,880 US$) per annum. The working days/annum were 360 day and the exchange was SDG 2.5 for $1(2009). There was insignificant difference (P>0.05) in income generated in the three districts.

Table 3: The Daily Income Generated using the Working Donkeys (SDG)

Measure	Omdurman	Khartoum	Khartoum North	Khartoum State
Mean	20.5±9.8	17.5±9.8	21.9±5.0	20.0±15.0
Mode	15.0	15.0	21.9	15.0
Range	4.0-80.0	5.0-80.0	10.0-40.0	4.0-80.0

Association between the daily income and Gastrointestinal parasites, and Blood parasites:
The study revealed that there was significant (P< 0.05) negative correlation (r=-0.146) between the daily income generated and infection with gastrointestinal parasites. The association was insignificant (P> 0.05) and negatively correlated between the daily income and egg burden (r = -0.048). There was a weak insignificant (P > 0.05) relation (r= .098) between the daily income and the infection with blood parasites.

Association between the daily income and some selected parameters:
There was insignificant (P > 0.05) correlation(r= 0.068) between the daily income and the age of the donkey and insignificant (P > 0.05) correlation (r= -.004) between the daily income and the body weight (r=-0.004).
There was a significant low positive correlation (P < 0.05) between the daily income and deworming and between the daily income and the PCV. The

77

correlation coefficient was 0.169 and 0.172 respectively. There was insignificant (P > 0.05) positive correlation between the daily income and health status and working ability.

Association between the infection with gastrointestinal, Blood parasites and some selected parameters:

The relationships between infection with gastrointestinal, blood parasites and the age, body weight, body condition scores, health status and working ability, deworming and the packed cell volume (PCV %) were examined. The relationship was positive and significant (P< 0.01) between the egg burden and the age of the donkey(r=0.226). A negative significant relationship (P< 0.01) existed between deworming and the infection with gastro-intestinal parasites (r= -0.214), deworming and egg burden (r=-0.202). The relationship was insignificant (P > 0.05) between the infection with gastrointestinal parasites and body weight (r=-0.004), body condition score(r=-0.069), health status and working ability (r=0.028) and the PCV(r=-0.111). The relationship was significant (P< 0.05) between infection with blood parasites and the health status and working ability of the donkey (r=-0.182). The relationship was insignificant (P > 0.05) between infection with blood parasites and body weight (r=0 .053), body condition score (-.066) and the PCV (r= -0.076).

Discussion

Like other African countries such as Ethiopia, Kenya, Nigeria and South Africa (Sisay, and Tilahun (2000); Hanekom (2000); Blench *et al* (2000); and Mukiria *et al* (2010), Donkeys were widely used in Khartoum State. Although their use is considered as backwardness (Marshal *et al.,* 1997), yet their role in the urbanization process in Khartoum State cannot be overseen.

There was no single building material shop without donkey drawn cart waiting beside. Moreover, special parking place was devoted to donkey carts in Sajana market at the center of Khartoum town. Transport of domestic materials in central markets and from wholesale to retailing shops is the usual task of donkey carts all over the State. They are cheaper and at disposal. As we move away from the center, donkeys contribute to solve the problems of underdevelopment where water need to be carried from wells to the domestic households and from one place to another. Unconstructed roads provide a good chance for donkey cart to operate as public transport. In addition to providing such services donkeys carts constitute a source of income generation to a good number of families especially at the outskirts of the three towns.

The age of working donkeys ranged between1-20 years with a mean 6.2.This finding was in consistence with those of Mexico (de Aluja & Lopez 1991). The use of immature donkeys was encountered in this study. Working donkeys of one year old were found in Omdurman. This might be due to the owners having little idea about the maturity age of the donkey or most probably the poverty of the owner lag behind the utilization of immature animals.

The weight of the donkeys investigated in this study ranged between 101 and 418Kg. This finding was different from that reported by Oudman (2004) for African donkeys which ranged between 120 and 180 kg. Furthermore, the maximum weight far exceeded the maximum weight reported by this author while the minimum weight was far less than that reported. He attributed the difference in weight to the good management which affected the growth rate and final body characteristics. This was better reflected in the present study in addition to breed difference in live weight.

The mean daily income generation reported in the present study was US$ 2,880 per annum which was more than double the minimum annual wage rate in Sudan (US$ 1,101) (absolute astronomy, 2011). This indicates that

operating a business using donkey is more profitable than some jobs in public or private sectors. The case resembled that in Addis Ababa where the minimum monthly net income of a Donkey Pack Transport Operations (Birr 125) in 1997 which was higher than the minimum salary of a civil servant of Birr 105 (Sisay and Tilahun, 2000). The average annual income generated by using donkeys in Khartoum State is much higher than the highest income generated in Makete, Tanzania which ranged between US$ 55 and US$ 124 per household (Sieber,2004).

The prevalence rate of gastrointestinal parasites reported in the present study was less than that reported by Seri *et al.,* (2004) in Khartoum State.

The prevalence of blood parasite was relatively low. Parasites found constitute *Piroplasm* (19.0%), *Microfliarea* (2.6%) and *Anaplasm* (1.6%). These are in agreement with results reported by Saul *et al.* (1997) in Eastern Ugand. No trypanosomes were found in the donkeys investigated in the present study. Conversely, donkeys in Burkina Faso and Ethiopia (Bengaly, *et al.* 2007; Mekibib *et al.* 2010) were found to be naturally infected with trypanosomes.

The average level of the packed cell volume reported in this study was 31.2 ± 4.3%. This was slightly less than the normal PCV of donkey of 32.42 ± 4.38% reported by Gull *et al.,* (2007). This indicated that the general health of the investigated donkeys in this study was within the range of normal.

Although donkeys are considered as beasts of burden in many developing countries (Crossley, 1991; Svendsen, 1997), yet this study proved that infection with gastrointestinal parasites had a significant negative impact on the daily income generated. Deworming on the other hand, has a significant positive relation with the daily income. Herd, (1990), Love, *et al.,* (1992), Mair, *et al.,* (1994) and Krecek and Gouthrie, (1999) all reported that heavy internal parasitic burden can affect the health of a donkey adversely. This study was in agreement with their findings. However, the negative

relationship between gastrointestinal parasites and the PCV was insignificant. This might be due to the fact that the rate of infection with gastrointestinal in this study could be considered as moderate (56.7 %).

Gastrointestinal parasite has significant negative relation with the health status and working ability in spite of the infection rate. i.e the donkey can be infected and still working but generate lower income. Ahmed *et al* (2008) reported similar findings in Borno State, Nigeria.

The body score condition (BCS) has a significant relationship with the daily income. Internal parasites in this study had insignificantly negative correlation with BCS. The overall impact of BCS on income is an accumulation effect of all health conditions including internal parasites. Asefa, *et al* (2011) reported similar finding.

The significant positive relationship between the daily income and PCV% and the indication that health status is a determining factor in income generation. The insignificant relationship between the daily income and the age of the donkey, daily income and the weight of the donkey were due to the fact that nearly all the donkeys investigated were mature and could perform their work regardless of age or weight. This in addition to the fact that owners were not so keen about the age and weight of the donkeys, and that the donkey should work and generate income regardless to its age or weight. De Aluja *et al.,* (1991) reached to the same conclusion.

Moreover, the significant positive relationship between the daily income and the health status and working ability of a donkey, reflected the importance of keeping a donkey in a good health in order to generate high return. Those who pay little attention to their sick donkeys underutilize the working power of the animal. Many owners paid little care to their sick animals. This finding was consistent with that reported by Wells et al.(1997) who stated that 20% of the owner never treated their donkeys.

Conclusion

The study concluded that donkeys play an important role as a mean of transport in the state. The average annual income generated was higher than the minimum wage level. In the study area gastrointestinal parasites were more prevalent than blood parasites. Gastrointestinal parasites had negative impact on income generation. The General health status of the investigated donkeys in Khartoum State was below normal reflected in the PCV been below the normal. The income generation was positively correlated to PCV hence the general health, so improvement of donkeys health would increase the income generated. Health status and working ability of donkeys was more related to blood parasites even under low prevalence, accordingly infection of blood parasites was more serious than gastrointestinal parasites. The study recommended application of deworming protocol in the state to improve the income generated by using donkeys.

Reference

Ahmed, M.I; Tijjani A.Nand Mustapha, A.R (2008): Survey for common diseases and management practices of donkeys (Equus asinus) in Brono State,Nigeria. Nigerian Veterinary Journal,29(3):1-5.

Ambawat, H.K., D.V. Malhotra, S. Kumar and S. Dhar, (1999): Erythrocyte associated hematobiochemical changes in *Babesia equi* infection experimentally induced in donkey. *Vet. Parasitol*., 85: 319-324.

Asefa, Z; Kuma, B; Endebu,B; Gizachew,A (2011): Endoparasites of Donkeysin Sululta and Gefersa Districts of Central Oroia,Ethiopia. Journal of Animal and Vet advances,10(14):180-1854.

Ayele G. Fescha G., Boja E. and Koe A. (2006): Prevalence of gastrointestinal parasite of donkeys in Dugda Bora District, Ethiopia. Livestock Research for Rural Development. 18, *Article #136.* Retrieved May 15, 2011, from http://www.lrrd.org/lrrd18/10/ayel18136.htm

Balkaya, I. , Utuk A. E. and Piskin, F. C. (2010): Prevalence of Theileria equi and Babesia caballi in Donkeys from Eastern Turkey in Winter Season *Pak Vet J*, 30 (4): 245-246.

Beja-Pereira Albano, Phillip R. England, Nuno Ferrand, Steve Jordan, Amel O. Bakhiet, Mohammed A. Abdalla, Marjan Mashkour, Jordi Jordana, Pierre Taberlet, Gordon Luikart (2004): African Origins of the Domestic Donkey *Science,* 304 (5678) : 1781

Bengaly, Z.; Sidibẽ, I., Millogo, L.; Sanogo, A., and Kadiogo, O. (2007): Epidemiology of African Animal Trypanosomosis in Donkeys in Burkina Faso. ISCTRC, 29th meeting, Luanda, Angola, 1-   5 October, 2007.

Blench,R; de Jode, A and Gherzi,E (2000): Donkeys in Nigeria: history, distribution and productivity. In : Donkeys, people and development. P.Starkey and D.A Fielding (eds).A resource book of Animal Traction Network or Eastern and Southern Africa (ATNESA). ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen,The Nethernlands.Pp. 210-219.

Crossely, P. (1991): Transport for rural development in Ethiopia. In: Donkeys, Mules and horses in tropical agricultural development: Feilding D and Pearson R A (edt) proceeding of collequrm hed in 3- 6 september, Edinburg, Scotlant, Center Tropical for Veterinary Medicine, University of Edinburg UK .336p.

Daclie, S. J. V. and Lwis, S. M. (1991): Determination of packed cell volume. In: Practical Haematology. Churchll Livingstone, Medical division of Longman Group UK limited pp 48-51.

De Aluja, A. S. and Lopez, F. (1991): Donkeys in Mexico. In: Donkeys, Mules and Horses in Tropical Agricultural Development, Fielding D and Pearson R A (Editors). CTV, Edinburgh. pp 1-7

Food and Agriculture Organisation, United Nations (1992): Production yearbook 46. FAO Statistics Series No 112 p 205. FAO: Rome

Githiori, J.B., Waithanji, E.M., Okech, G.O. and Ndung'u, J.M. (1998): Trypanosomiasis, helminthiasis, and other conditions of donkeys in Lamu and Mwingi Districts, Kenya. In: OAU/STRC,: 210-216.

Gul T., Ahmad M., Khan A. and Hussain I. (2007): haemato-biochemical observations in apparently healthy equine species - (Pakistan Vet. J., 27(4): 155-158.

Hamid, M.E., Fadia,Y.U (2001): Haematological and blood chemical changes in donkeys naturally infected with Onchocerca cervicalis and Strongylus spp. In Sudan.Sud J.Vet.Sc. Anim. Husb. 39(1&2):111-115.

Hassan, W.A and Ibitoye, B.A. (1999): Camels and Donkeys as Pack and Transport Animals in Semi-arid Northern Nigeria: Herd Composition, Management and Utilization. Proceedings of the Fourth Workshop of the West Africa Animal Traction Network, Kano, Nigeria, 9-13 July1990.

Hanekom, D.(2000): The use of donkeys for transport in South Africa. In : Donkeys, people and development. P.Starkey and D.A Fielding (eds). A resource book of Animal Traction Network or Eastern and Southern Africa (ATNESA). ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen,The Nethernlands.Pp. 210-219.

Herd, R.P. (1990): The changing world of the worms: The rise of the cyathostomes and the decline of *Strongylus vulgaris Comp.* Cont.Edu.Pract.Vet..VET. 2: 732-736.

Kanchula, E. and Abebe, G. (1997): Donkey's trypanosomiasis in Northern Omo Zone, South West Ethiopia. Ethiopian Veterinary Journal. 1:13–18.

Krecek, R. C., Guthrie, A. J. (1999): Alternative approaches to control of cyathostomes: an African perspective. Vet. Parasitol. 85: 151-162.

Kumar, S., . Malhotra D. V, Dhar S. and . Nichani A. K (2002): Vaccination of donkeys▸ against Babesia equi using killed merozoite immunogen Veterinary Parasitology , 106, (1) : Pages 19-33.

Kumar S, Kumar R, Sugimoto C. (2009): A perspective study on *Theileria equi* infections in donkeys. Jpn J Vet Res.<u>56</u>(4):171-80.

Love, S., Mair, T. S., Hillyer, M. H. (1992): Chronic diarrhoea in adult horses: a review of 51 referred cases.Vet. Res. <u>130</u>: 217-219.

Mair, T. S. (1994): Outbreak of larval cyathostomiasis among a group of yearling and two year-old horses. Vet. Rec. <u>135</u>: 598- 600.

Marshal, K., Ali, Z., and Terfa, B. (1997): Socioeconomic issues of donkey use in Ethiopia; A case study of changing relationship. Paper prepared for *(ATNESA). Workshop*, on improving donkey utilization and management Debre Zeit, Ethiopia 5-9 May 1997.

Mekibib, B., Manegerew, M., Tadesse, A., Abuna, F., Megersa, B., Regassa, A., Mekuria. S. and Abebe, R. (2010): Prevalence of Bloodparasites and associated risk factors in working donkeys in Adigudem and Kwiha districts of Tigray region, Northern Ethiopia. The Internet Journal of Veterinary Medicine. <u>8</u> (1).

MARF: Ministry of Animal Resources anf Fisheries (2009) Annual Report.

Mukiria, P., Mdachi R., Thuita J., Mutuku J., Wanjala K., Omolo J., Mulugeta G., Trawford A., Ouma1 J. and Murilla G. (2010): Semi-longitudinal study of trypanosomiasis and its vectors in donkeys proceedings of the 12th KARI biennial scientific conference

Oudman, L., (2004): Donkeys for traction and tillage, Agromisa Foundation, Wageningen,.Second edition: 2004: Jan H. Loedeman (ed) Printed by: Digigrafi, Wageningen, The NetherlandsISBN: 90-77073-95-7 NUGI: 835.

Rabeh, A. (2009): Chairman of the Donkey Carts Trade Union – Mayo-Gebel awliya – Khatoum. Personal communication,

Pritchard JC, Lindberg AC, Main DC, Whay HR. (2005): Assessment of the welfare of working horses, mules and donkeys, using health and behaviour parameters. Prev Vet Med.; <u>69</u> (3-4):265-83.

Saul, C.; Siefert, L. and Opuda-Asibo, J. (1997): Disease and health problems of donkeys: a case study from eastern Uganda. Paper presented at the international Animal Traction Network for Eastern and Southern Africa (ATNESA) workshop held 5-9 May 1997. Debre Zeit, Ethiopia. Available at:
http://www.atnesa.org/atnesa-donkey-workshop-report.pdf

Seri, H. I.; T. Hassan; M.M. Salih; A.D. Abakar (2004): A survey of gastrointestinal nematodes in donkeys (*Equus asinus*) in Khartoum State, Sudan. Journal of Animal and Veterinary Advances. <u>3</u> (11): 736-739.

Sieber, N. (2004): The economic impact of pack donkeys in Makete, Tanzania International Forum for Rural Transport and Development in: Starkey P and Fielding D (eds), Donkeys, people and development. 244p.
http://www.atnesa.org

Sisay, Z., and Tilahun F.,(2000): The role of donkey pack-transport in the major grain market of Addis Ababa. In Donkeys, people and development, P. Starkey and D. Fielding (eds). A resource book of the Animal Traction Network for Eastern and Southern Africa (ATNESA). ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. pp. 71-78. available at http://www.atnesa.org

Soulsby, E. J. L. (1986): Helminths, Arthropods & Protozoa of Domesticated Animals. 7th Edition, pp 790, Bailliere tindall (London).

Starkey, P. and M. Starkey. (1997): Regional and World trends in Donkey Populations. In: Donkeys, people and development. Starkey P and Fielding D (eds), A resource   book of the Animal Traction Network for Eastern and Southern Africa (ATNESA). ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands.244p.   available at http://www.atnesa.org

Statistical Year Book (2009): Central Bureau of Statistics. p42 http://www.cbs.gov.sd/en/node/146

Svendsen, E. D.(1997): The Professional Handbook of the Donkey, 3rd edn. Whittet Books LTD, W14OBY, London; pp 166 – 182. (s)

Urquhart, G. M.; Armour, J.; Duncan, J. L.; Dunn, A. M. and Jennings, F. W. (ed.). (1996): Veterinary Parasitology. Second Edition, pp 307.

Vall E., Ebangi A.L., Abakar O.. (2003): A method for estimating body condition score (BCS) in donkeys. In: Working animals in agriculture and transport: Pearson R.Anne, Lhoste Philippe, Saastamoinen Markku and Martin RossetWilliam (eds). A collection of some current research and development observations. Wageningen Academic Publishers, p. 93-102. EAAP Annual Conference. 53, 2002-09-01/2002-09-04, Caire, Egypte.

Wells, D; Krecek R.C and Kneale,J.A .(1997): Socio-economic and health aspects of donkeys in North-West and Eastern Cape provines,South Africa. In In: Donkeys, people and development. Starkey P and Fielding D (eds), A resource book of the Animal Traction Network for Eastern and Southern Africa (ATNESA). ACP-EU Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands.244p. available at http://www.atnesa.org

Web Sites

http://www.miniature-donkey-assoc.com/worming.htm) 13/02/2011 Miniature Mediterranean Donkey Association is a Private Company Limited by Guarantee. Registered No. 4642344. Company Secretary: Mrs. P. Cooke (http://www.absoluteastronomy.com/topics/List_of_minimum_wages_by_country, 2011).