Asia Pacific Journal of Sustainable Agriculture Food and Energy (APJSAFE)

Assessment of cattle welfare on Ghanaian farms

Joshua Wuntimah Salifu Mogre*, Frederick Adzitey, and Gabriel Ayum Teye

University for Development Studies, Faculty of Agriculture, Food and Consumer Sciences, Department of Animal Science, P.O. Box TL 1882, Tamale, Ghana.

**Corresponding author's E-mail address: jmogre@gmail.com*

Abstract — The objectives of the study were to assess farm welfare conditions and the observance of welfare by cattle farmers in Ghana. The study applied field approaches to gather and analyze data. Data was collected from farms in the Northern, North East and Savanna regions. A total of three hundred and eighteen (318) cattle farmers were interviewed using semi-structured questionnaire. Observations and focus group discussions were also used to obtain data or verify some of the responses from the cattle farmers. Data collected was classified and summarized based on the information provided. The study found evidence that most farmers were concerned about their animal's welfare but did not place equal weight on the five freedoms of animal welfare. Farmers placed the most premium on freedom from hunger, malnutrition, and thirst (95%), and freedom from pain, injury and disease (90%). Farmers placed less premium on their animals' freedoms from fear and distress (50%), and freedom from physical and thermal discomfort (50%). The freedom to express normal patterns of behaviour (0%) was not considered by the farmers. Observance of animal welfare by cattle farmers was relatively below acceptable standards and government interventions are needed to improve animal welfare in Ghana.

***Keywords*— Animal Welfare, Cattle, Farmers, Ghana, Stockmanship.**

Received: 30 November 2021
Accepted: 22 December 2021

INTRODUCTION

Animal welfare refers to how an animal is coping with the conditions in which it lives (Broom, 2011). According to the World Organization for Animal Health (OIE) Terrestrial Code: "animal welfare means the physical and mental state of an animal in relation to the conditions in which it lives and dies" (OIE, 2019). An animal is in a good state of welfare if it is healthy, comfortable, well nourished, safe, and able to express its innate behavior (Veasey, 2017). Additionally, it should not be suffering from unpleasant states such as pain, fear and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management and nutrition, humane handling and humane slaughter or killing (Broom, 1991; Hewson, 2003).

The OIE guiding principles on animal welfare also mentioned the universally recognized "Five Freedoms", published in 1965 to describe the right to welfare of animals under human control (OIE, 2017). According to this concept, an animal's primary welfare needs are when it experiences freedom from: hunger, malnutrition, and thirst; fear and distress; physical and thermal discomfort; pain, injury and disease; and freedom to express normal patterns of behavior.

According to Meat and Milk for Africa (2020), the livestock sector accounts for about 40% of agricultural GDP in Africa, ranging from 30 to 80% in individual countries. Also in Africa, close to 300 million people depend on livestock for their income and livelihood (Dessie and Mwai, 2019). In Ghana, the economic contribution from the livestock subsector has increased steadily with a recorded 5.7% growth in this sector in 2018 (Dessie and Mwai, 2019). Livestock play an important role to many people on the continent. However, little or no provision for animal welfare is made in the laws and regulations of most developing countries (Moss, 1994).

Studies on animal welfare are extremely important for a developing country like Ghana. When farmers give attention to the welfare of their animals, they obtain vast benefits. Animals raised in a good environment are less susceptible to diseases, reach their genetic potential faster and are more productive. This translates to a lower cost of production for the farmer, which eventually affects his profit margins positively.

In recent years, animal welfare has become an issue of increasing concern in several countries worldwide, including countries in Africa. Compliance with animal welfare standards is now becoming more often included in trade agreements. Animal welfare issues from farm to slaughter are very important and this requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and slaughter. The objective of the study was to evaluate farm conditions from the standpoint of welfare and the observance of welfare by cattle farmers.

MATERIALS AND METHODS

A. Location

Ghana is situated on the west coast of Africa with a total area of 238,540 Km^2 (Claude, 2009). Ghana is found approximately between Latitude and Longitude 8o 00' and 20 00' (Kumi-Boateng and Ziggah, 2020). The country is

divided into 16 administrative regions and has a population of 3.8 million (GSS, 2021).

Figure 1: Map of Ghana showing the study

The study was carried out in eleven (11) district assemblies, municipalities and/or metropolis in the Northeast, Northern and Savanna regions of Ghana. The eleven (11) district assemblies, municipalities and/or metropolis were: Saboba, Kumbungu, Tolon, Mion, Nanton and Central Gonja districts; the West Mamprusi, Yendi, Sanarigu, Savelugu municipalities and the Tamale metropolis were also chosen.

B. Sampling Procedure

A total of three hundred and eighteen (318) farmers in the Northern zone were selected purposively and interviewed using semi-structured questionnaires according to their availability during the study. Observations were also made to further assess farm conditions from a welfare standpoint. The data collected was analyzed using descriptive statistics and the results presented in the form of percentages in tables. The northern zone was chosen to sample farmers for the ensuing reasons: 1) This zone has a higher density of cattle farmers and is the main cattle rearing zone in Ghana (Nuvey et al., 2020) and 2) The zone gave the researchers access to rural, peri-urban and urban cattle farmers. This gave a better picture of the complete state of cattle farming in Ghana.

C. Parameters for Welfare Assessment

To assess welfare standards critical observation of animal behaviour, farmer's stockmanship, and farm structures were conducted. Detailed questions were asked to understand the history of the farms, farmers' technical knowledge, and their perceptions of welfare. Observations and questions were structured around the five guiding principles of freedom from: hunger, malnutrition, and thirst; fear and distress; physical and thermal discomfort; pain, injury, and disease; and freedom to express normal patterns of behaviour.

D. Data Analysis

Data collected from respondents were classified and summarized on the basis of the information provided by the respondents. Responses were summarized into frequencies and percentages; Cramer's V was used to test the null hypothesis that there is no association between years of experience and each of the variables under: The Cramer's V analysis was done using the Cross-tab sub command under the descriptive statistics in Statistical Package for Social Sciences (SPSS, 2013)

RESULTS AND DISCUSSIONS

RESULTS

Farm Observation

The demographic details of the cattle farmers are shown in Table 1 and results of farm welfare assessment are presented in Table 2. Table 3 shows Cramer's V analysis as selected variables were used to assess the five guiding freedoms of animal welfare.

Table 1. Demographic details of farmers

Demographic

Indicator	Farmers
Age (%)	
Below 18	3.8
18-40	57.2
41-60	37.7
61-Above	1.3
	100
Education (%)	
None	51
Primary	21.4
Secondary	15.7
Tertiary	11.9
	100
Years of Experience (%)	
0-5	23.3
6--10	27
11--15	21.4
15- Above	28.3
	100

Table 2. Farm assessment by observation

Animal handling	**Yes**		**No**		**Chi Square**	
	Number of farms	%	Number of farms	%	Stat	P Value
Housing	82	25.8	236	74.2	74.6	<0.001
Alternative housing for rainy season	60	18.9	258	81.1	118.2	<0.001
Exposure of animals to harsh weather conditions	279	87.7	39	12.3	182.3	<0.001
Separate quarters for different animals (age and/sex)	44	13.8	272	86.2	166.4	<0.001
Demarcation of farm	122	38.4	196	61.6	17.2	<0.001
Animals protected from theft	180	56.6	138	43.4	5.5	0.019
Adequate feeding troughs	100	31.4	218	68.6	42.6	<0.001
Adequate drinking troughs	191	60.1	127	39.9	13.0	<0.001
Presence of prophylactic medication	122	38.4	196	61.6	18.3	<0.001
Isolation Area	42	13.2	276	86.8	172.2	<0.001
Presence of record books	60	18.9	258	81.1	121.6	<0.001
Animals seem stressed	10	3.1	308	96.9	277.3	<0.001
Overcrowding	88	27.7	230	72.3	67.9	<0.001
Was farmer calm around animals	296	93	22	7	284.2	<0.001
Presence of farm equipment	100	31.4	218	68.6	44.9	<0.001

Table 3. Evaluation of association of years of experience of farmers with five freedom parameters

Freedoms	Variable	Stat	P Value
Hunger malnutrition and thirst	Farming system	0.15	0.285
	Feeding practices	0.18	0.016
	Use of mineral supplements	0.24	0.005
Fear and distress	Threat of herd to wild animals	0.45	<0.001
	Ability of farmers to detect stress in animals	0.21	0.027
	Knowledge of the sources of stress in their herds	0.40	<0.001
Physical and thermal discomfort	Housing provided	0.24	<0.001
	Housing practices in the rainy season	0.26	<0.001
Pain, injury and disease	Persons who treat sick animals	0.29	<0.001
	Their understanding of signs of disease	0.18	0.043
	How often animals are inspected for disease conditions	0.38	<0.001
Express normal patterns of behaviour	Knowledge of behaviour of animals' exhibit	0.49	<0.001
	Animals' response to commands	0.34	<0.001
	Their ability to notice change in behaviour	0.14	0.361

Table 4. Comparing feeding methods in the rainy and dry seasons

Rainy Season			**Dry Season**		
Feeding	Number of farms	Percent (%)	Feeding	Number of farms	Percent (%)
Grazing	262	82.4	Grazing	240	75.5
Cutgrass	28	8.8	Cutgrass	20	6.3
Cut tree branches	4	1.3	Grinding mill waste	30	9.4
Grinding mill waste	10	3.1	Formulated feed	16	5.0
Formulated feed	14	4.4	Grazing and grinding mill waste.	2	.6
			Grazing and cassava peels	2	.6
			Grazing and cutgrass	2	.6
			Kitchen waste	6	1.9
Total	318	100.0	Total	318	100.0

The maximum and minimum herd size was 120 and 2 respectively, the average herd size was 25 animals.

Farm evaluation of freedom from hunger, malnutrition and thirst

With regards to feeding, 38% of the farmers fed animals ad libitum, 1% fed once a day with 61% feeding their animals twice a day. Farmers fed animals in the morning and evening with 90.6% grazing their animals on free range.

As shown in Table 4, in the rainy/wet season the main method of feeding is to allow animals to graze grass (82.4%). In the dry season although animals were still grazed, supplementary feeds were provided. In both the dry and rainy seasons, farmers allowed animals to graze freely for 10-12 hours during the day.

Farm evaluation of freedom from fear and distress

To determine farmers' appreciation of fear and distress within their herds farmers were asked the common sources of fear within the herd (Table 5). A quarter (25 %) attributed fear to the presence of reptiles (snakes), 23% believed fear in the herd was caused by paranormal sources.

Table 1. Causes of fear/ distress in herd

Triggers of fear	Number of farmers	Per (%)
Loud noise	18	6
Paranormal	73	23
People throw projectiles (e.g. stones)	36	11
Reptiles (Snakes)	79	25
Intruders	34	11
Nothing	56	18
Dogs/Wild animals	14	4
Insects (Bees, Tsetse flies)	8	3
Total	318	100

Farmers identified signs of fear and distress in their animals by raised tails, bellowing, huddling, agitated movement, refusal to move, running and jumping, lying down and change in normal routine. A few (4.4%) of farmers stated that they could not identify signs of fear in their animals. Farmers adopted the following means to calm an agitated herd of cattle; 32.9% used vocal commands and movement, 32.9% removed the source of distress, 28.9% would allow animals to rest, 2.6% beat animals with sticks in an attempt to stop the agitation and 2.6% did nothing at all.

Farm evaluation of freedom from pain, injury and disease

The signs farmers observed for disease were loss of appetite (57.2%), physical dullness (39%) and physical changes of the skin, hooves and orifices (3.8%). Sick animals were treated by veterinary officers (57.2%), self-treatment (27.7%) and by other farmers (15.1%). Cattle were inspected for diseases daily by almost half (48.8%) of the farmers, weekly by 18.7% of the farmers, monthly by 20.6% of farmers, 9.4% only when animals looked sick and 2.5% at random. Majority of the farmers (69.2%) had no treatment plan, while 30.8% had rudimentary treatment plans. Treatments were carried out at regular intervals by 42.7% of farmers, 18.7% carried out treatment at the beginning of the rainy season only, 1.3% carried out treatment on new animals to be introduced into their farms and 37.3% treated animals only when signs of sickness were identified. Farmers generally had poor methods of storing their animal medication.

Farmers carried out various veterinary activities on their farms, some (32.7%) of the farmers assisted their cows in calving, 23.3% carried out castration, 30.8% did dehorning, 70.4% carried out parasite control, and 24.1% trimmed overgrown hooves.

Farm evaluation of freedom to express normal patterns of behaviour

Farmers generally found their animals to be calm and playful (89.4%) and a minority (10.6%) reported aggressive animals. Nearly all farmers (99.4%) were able to detect changes in behaviour of their animals. Majority (93%) of the animals responded to vocal commands and hand gestures. Most farmers (82.4%) admitted they had emotional attachment to their animals and were not always keen on selling them. However, 17.6% considered their farming a commercial venture and had no emotional attachment to their animals.

Farm evaluation of freedom from physical and thermal discomfort

Out of all the farms visited, 78% of farms had animals in an open space, 14% had a kraal and 8% had stalls/sheds. There was no change in housing system during the rainy season. In the hot season animals are left in the heat and could be seen congregating under trees where available. In the rainy season animals were left in the rain in most occasions. Only 13.2% of farms had housing/ demarcated area for sick animals. All farms kraaled animals together with no separation according to age or sex. On the average farms were cleaned twice in a month. Most (63.5%) farmers transported their animals to markets for sale on motor tricycles, 20.1% sold their animals at the farm gate, while 16.4% used trucks when sending cattle to the markets/congregation points.

From focus group discussions, farmers placed the most premium on freedom from hunger, malnutrition and thirst (95%), and freedom from pain, injury and disease (90%). Farmers took less proactive steps to guard their animals from freedoms of fear and distress (50%), and freedom from physical and thermal discomfort (50%). The freedom to express normal patterns of behavior (0%) was not one that they actively considered or proactively took steps to safeguard.

Discussion

The objective of this study was to evaluate farm welfare conditions and observance of welfare by cattle farmers in Ghana. The farms in this study can be classified as small herd sizes, as the range of herd size falls within that

reported for sub–Saharan Africa by Otte and Chilonda (2002). Most farmers were middle aged with no education. This agrees with findings by Nuvey *et al*. (2020) who found the mean age of cattle farmers to be 46.9 ± 11.7 years and almost all the respondents were male (93%) and had some basic education (46%). In this study none of the respondents were female. The low level of participation of women in the cattle industry has also been widely reported by Hovorka (2012), Quisumbing *et al*. (2015) and Zakaria *et al*. (2015). Majority (75%) of farms visited had no form of housing, and animals were exposed to the weather all year round. Since there was no change in housing system during the rainy season, this exposed cattle of all ages to thermal discomfort. Shade seeking behaviour observed in this study suggests that cattle were exposed to extreme heat which could lead to thermal discomfort. According to Van Laer *et al*. (2015), in tropical regions, heat stress (behavioural and physiological effects of hot ambient conditions) has been thoroughly documented to negatively impact the health, welfare and productivity of unsheltered cattle.

None of the farmers listed thermal discomfort as a welfare challenge to their herds, it can be inferred that even though these animals are exposed to high thermal stresses their inherent genetic adaptation to heat stress has mitigated the dire effects of the heat conditions they are exposed to as stated by Hammond *et al*. (1996), Katiyatiya *et al*., (2014), Kim *et al*. (2017) and Li *et al*. (2020).

The farming systems identified were peri-urban livestock-production systems and non-nomadic pastoralism or extensive system. These results corroborate with the findings of Smith *et al*. (1998), Scholtz *et al*. (2011) and Roessler *et al*. (2016). The non-nomadic pastoralism system of farming requires few inputs from farmers (mainly labour), and the constant movement of cattle for grazing exposes the cattle to many stressors and potential injuries through insect and reptile bites. Furthermore, cattle activities can have a detrimental effect on the environment through over grazing which can cause erosion and soil degradation. Even though the peri-urban farmers encountered did graze their animals, there was a greater emphasis on supplementary feeding. The absence of feeding troughs on most farms indicated that supplementary feeds were poured onto the ground as observed in many farms. It also indicates the high reliance of farmers on grazing. About 40% of animals on the farm only had access to drinking water when they trekked to open water bodies such as dams. The competition for water between humans and livestock observed in both rural and urban farms is similar to that of Naiga *et al*. (2015) who stated that animal farming contributes to contamination and water scarcity, as both humans and animals compete for the same water source. On the same observation, Water Resources and Livestock (2021) stated that humans, animals and plants compete for water, and it is by far the most important limiting factor in livestock production.

This reliance on grazing and limitations of water, challenges the animal's freedom from hunger, malnutrition and thirst, since the availability of food and water is seriously hampered by seasonal rainfall. This can cause wide fluctuations in the body conditions of cattle. It was observed in the rainy season that cattle were in better physical condition as compared to the dry season for the non-nomadic pastoral farmers. The cattle of peri-urban farmers had smaller fluctuations in their conditions between seasons. The challenge of hunger, malnutrition and thirst is a situation imposed on the farmers and not generated out of neglect or intentional harm to the animals as suggested by Woods (2012) and Taylor and Fraser (2019).

The absence of a treatment unit or area and prophylactic drugs on most farms indicate that most farmers did not have a commercial farming approach to their farming module. Farmers were found to use medicinal plants to treat some cattle health conditions which is in agreement with observations made by Sher and Alyemeni (2011), Parthiban *et al*. (2016) and Mushtaq *et al*. (2018).

Nearly all animals encountered on the farms were in a calm state and were not crowded. Farmers were also calm around their animals which shows good stockmanship in their handling. Farmers showed a great degree of astute stockmanship, while some farmers named their animals and spoke directly to the animals while engaging them. Good stockmanship is known to have many benefits to the farmer and the animals as well. Rushen and Passillé (2017) stated that skilled stockmanship will promote animal welfare and animal productivity. Dairy cows and other animals which are afraid of humans gain less weight, produce less milk, and have decreased reproductive performance. It is possible that farms with animals that are willing to approach people will be more productive (Rushen and Passillé, 2017). A very important component of farming that affects both animal welfare and animal productivity is the people who care for the animals. Rushen and Passillé (2017) stated that, the knowledge or technical competence of the stockperson can play a major role if it leads to improper choice of housing, poor feeding methods or lack of appropriate treatment of illness, and the quality and diligence with which routine tasks are done can be also be important. Zulkifli (2013) has shown that the way that animals are handled by people can have a major effect on their welfare.

Farmers were generally conversant with the sources of distress within the herd. These sources of distress are also reported by Allen (2014), Denning *et al*. (2014) and Wallach *et al*. (2017). Sources of stress such as cold, heat, handling, transporting, temperament, introduction to a new flock, diseases and parasites reported by Gebregeziabhear and Ameha (2015) and Chebel *et al*. (2016) were not considered by farmers in this study to be major causes of stress. This implies that farmers appreciation of stressors to animals is limited and had implications for the animal welfare on their farms. The belief in paranormal triggers is an indicator that cattle farming in some areas is still very traditional and steeped in elements of mysticism. These results are similar to that of Parkes (1987), Misra and Kumar (2004), Wanzala *et al*. (2005) and Komwihangilo *et al*. (2007) who identified the belief in the supernatural as part of the animal rearing traditions.

Farmers used behavioural signs such as raised tails, bellowing, huddling, agitated movement, refusal to move, running and jumping, lying down and change in normal routine to identify signs of fear and distress in their animals. These signs of fear are widely accepted as reported by Forkman *et al*. (2007), Grandin and Shivley (2015) and Lindahl *et al*. (2016).

With regards to freedom from pain, injury and disease, farmers regularly inspected their animals for diseases, and had rudimentary treatment plans. Most of the farmers kept medication in locations that could affect the efficacy of the drugs since the drugs were exposed to heat and direct sunlight. Farmers carried out various activities on their farms such as assisting cows in calving, castrations, dehorning, parasite control, and trimming of overgrown hooves which can promote the health of animals.

The limited access of farmers to veterinary and extension services has resulted in some farmers carrying out self-treatment or depending on other farmers to treat their animals. This was also reported by Mockshell *et al*. (2014), who stated that access to high-quality animal health services is still a major issue for Ghana's livestock-dependent communities. Farmers in places where there are few or no government para-vets have resorted to self-treatment or selling sick animals for consumption, both of which have negative health consequences. Traoré *et al*. (2020) also documented the use of indigenous knowledge of medicinal plants for the treatment of cattle diseases such as foot and mouth disease and trypanosomiasis by Fulani and Lobi farmers instead of the use of veterinary services.

Farmers (82.4%) admitted they had emotional attachment to their animals and were not always keen on selling them. Ghanaian farmers emotional attachment to their cattle was also reported by Nuvey *et al*. (2020). From Table 3, results showed that years of experience was significantly associated with nearly all parameters with regards to the five freedoms. Only two indicators namely "farming systems" and "ability to notice changes in behaviour" were not significantly associated ($P>0.05$) with years of experience of farmers. This indicates that the year of experience of farmers played an important role in their understanding and adoption of welfare issues or methods. Farmer's years of experience among other factors have been reported to affect their attention to animal welfare issues (Coleman *et al*., 2003; Dockes and Kling-Eveillard, 2006; Kauppinen *et al*., 2012).

CONCLUSIONS

The findings show that farmers were aware of their animal's welfare needs and attempted to address them. Ghanaian cattle farmers were concerned about their animal's welfare but did not place equal weight on the five freedoms of animal welfare.

REFERENCES

Allen, L. R. (2014). Wild dog control impacts on calf wastage in extensive beef cattle enterprises. Animal Production Science, 54(2), 214. https://doi.org/10.1071/AN12356

Broom, D. M. (1991). Animal welfare: concepts and measurement. In Journal of animal science (Vol. 69, Issue 10, pp. 4167–4175). J Anim Sci. https://doi.org/10.2527/1991.69104167x

Broom, Donald M. (2011). A History of Animal Welfare Science. In Acta Biotheoretica (Vol. 59, Issue 2, pp. 121–137). https://doi.org/10.1007/s10441-011-9123-3

Chebel, R. C., Silva, P. R. B., Endres, M. I., Ballou, M. A., and Luchterhand, K. L. (2016). Social stressors and their effects on immunity and health of periparturient dairy cows1. Journal of Dairy Science, 99(4), 3217–3228. https://doi.org/10.3168/jds.2015-10369

Claude, M. (2009). Food and Agriculture Organization Of The United Nations Food Insecurity and Vulnerability Information and Mapping Systems Nutrition Country Profile Republic Of Ghana. https://www.moh.gov.gh/wp-content/uploads/2016/02/Nutrition-Country-Profile-Ghana.pdf

Denning, S. S., Washburn, S. P., and Watson, D. W. (2014). Development of a novel walk-through fly trap for the control of horn flies and other pests on pastured dairy cows. Journal of Dairy Science, 97(7), 4624–4631. https://doi.org/10.3168/jds.2013-7872

Dessie, T., and Okeyo Mwai, A. (2019). The story of cattle in Africa: Why diversity matters. ILRI, Rural Development Administration, Republic of Korea and AU-IBAR. https://cgspace.cgiar.org/handle/10568/108945

Forkman, B., Boissy, A., Meunier-Salaün, M. C., Canali, E., and Jones, R. B. (2007). A critical review of fear tests used on cattle, pigs, sheep, poultry and horses. Physiology and Behavior, 92(3), 340–374. https://doi.org/10.1016/j.physbeh.2007.03.016

Gebregeziabhear, E., and Ameha, N. (2015). The Effect of Stress on Productivity of Animals:A Review. 5(3). www.iiste.org

Grandin, T., and Shivley, C. (2015). How farm animals react and perceive stressful situations such as handling, restraint, and transport. In Animals (Vol. 5, Issue 4, pp. 1233–1251). MDPI AG. https://doi.org/10.3390/ani5040409

GSS. (2021). Ghana Statistical Service. September 1–7. www.census2021.statsghana.gh

Hammond, A. C., Olson, T. A., Chase, C. C., Bowers, E. J., Randel, R. D., Murphy, C. N., Vogt, D. W., and Tewolde, A. (1996). Heat tolerance in two tropically adapted Bos taurus breeds, Senepol and Romosinuano, compared with Brahman, Angus, and Hereford cattle in Florida. Journal of Animal Science, 74(2), 295. https://doi.org/10.2527/1996.742295x

Hewson, C. J. (2003). What is animal welfare? Common definitions and their practical consequences. In The Canadian Veterinary Journal (Vol. 44, Issue 6, pp. 496–499). http://www.scopus.com/inward/record.url?eid=2-s2.0-0038016423andpartnerID=40andmd5=3e7642782f751d5061f5608394924dd4

Katiyatiya, C. L. F., Muchenje, V., and Mushunje, A. (2014). Farmers' perceptions and knowledge of cattle adaptation to heat stress and tick resistance in the Eastern Cape, South Africa. Asian-Australasian Journal of Animal Sciences, 27(11), 1663–1670. https://doi.org/10.5713/ajas.2014.14174

Kim, J., Hanotte, O., Mwai, O. A., Dessie, T., Bashir, S., Diallo, B., Agaba, M., Kim, K., Kwak, W., Sung, S., Seo, M., Jeong, H., Kwon, T., Taye, M., Song, K.-D., Lim, D., Cho, S., Lee, H.-J., Yoon, D., … Kim, H. (2017). The genome landscape of indigenous African cattle. Genome Biology 2017 18:1, 18(1), 1–14. https://doi.org/10.1186/S13059-017-1153-Y

Komwihangilo, D. M., Lekule, F. P., Kajembe, G. C., and Petersen, P. H. (2007). Role of Local Knowledge in Mixed Livestock Production Systems. Outlook on Agriculture, 36(3), 187–192. https://doi.org/10.5367/000000007781891513

Kumi-Boateng, B., and Ziggah, Y. Y. (2020). A 3D Procrustean Approach to Transform WGS84 Coordinates to Ghana War Office 1926 Reference Datum. Ghana Mining Journal, 20(1), 1–10. https://doi.org/10.4314/gm.v20i1.1

Li, R., Li, C., Chen, H., Li, R., Chong, Q., Xiao, H., and Chen, S. (2020). Genome-wide scan of selection signatures in Dehong humped cattle for heat tolerance and disease resistance. Animal Genetics, 51(2), 292–299. https://doi.org/10.1111/age.12896

Lindahl, C., Pinzke, S., Herlin, A., and Keeling, L. J. (2016). Human-animal interactions and safety during dairy cattle handling-Comparing moving cows to milking and hoof trimming. Journal of Dairy Science, 99(3), 2131–2141. https://doi.org/10.3168/jds.2014-9210

Misra, K. K., and Kumar, K. A. (2004). Ethno-veterinary Practices Among the Konda Reddi of East Godavari District of Andhra Pradesh. Studies of Tribes and Tribals, 2(1), 37–44. https://doi.org/10.1080/0972639x.2004.11886502

Mockshell, J., Ilukor, J., and Birner, R. (2014). Providing animal health services to the poor in Northern Ghana: Rethinking the role of community animal health workers? Tropical Animal Health and Production, 46(2), 475–480. https://doi.org/10.1007/s11250-013-0518-9

Mushtaq, S., Shah, A. M., Shah, A., Lone, S. A., Hussain, A., Hassan, Q. P., and Ali, M. N. (2018). Bovine mastitis: An appraisal of its alternative herbal cure. In Microbial Pathogenesis (Vol. 114, pp. 357–361). Academic Press. https://doi.org/10.1016/j.micpath.2017.12.024

Naiga, R., Penker, M., and Hogl, K. (2015). Challenging pathways to safe water access in rural Uganda: From supply to demand-driven water governance. International Journal of the Commons, 9(1), 237–260. https://doi.org/10.18352/ijc.480

Nuvey, F. S., Kreppel, K., Nortey, P. A., Addo-Lartey, A., Sarfo, B., Fokou, G., Ameme, D. K., Kenu, E., Sackey, S., Addo, K. K., Afari, E., Chibanda, D., and Bonfoh, B. (2020). Poor mental health of livestock farmers in Africa: A mixed methods case study from Ghana. BMC Public Health, 20(1), 825. https://doi.org/10.1186/s12889-020-08949-2

OIE World Organization for Animal Health. (2017). Animal welfare strategy in africa (awsa) final version.

Parkes, P. (1987). Livestock symbolism and pastoral ideology among the Kafirs of the Hindu Kush. Man, 22(4), 637–660. https://doi.org/10.2307/2803356

Parthiban, R., Vijayakumar, S., Prabhu, S., and Morvin Yabesh, J. G. E. (2016). Quantitative traditional knowledge of medicinal plants used to treat livestock diseases from Kudavasal taluk of Thiruvarur District, Tamil Nadu, India. Revista Brasileira de Farmacognosia, 26(1), 109–121. https://doi.org/10.1016/j.bjp.2015.07.016

Roessler, R., Mpouam, S. E., Muchemwa, T., and Schlecht, E. (2016). Emerging development pathways of urban livestock production in rapidly growing West Africa cities. Sustainability (Switzerland), 8(11). https://doi.org/10.3390/su8111199

Rushen, J., and Passillé, A. M. de. (2017). The importance of good stockmanship and its benefits to animals. Improving animal welfare: a practical approach (pp. 125–138). CABI. https://doi.org/10.1079/9781780644677.0125

Scholtz, M. M., McManus, C., Okeyo, A. M., and Theunissen, A. (2011). Opportunities for beef production in developing countries of the southern hemisphere. Livestock Science, 142(1–3), 195–202. https://doi.org/10.1016/j.livsci.2011.07.014

Sher, H., and Alyemeni, M. N. (2011). Pharmaceutically important plants used in traditional system of arab medicine for the treatment of livestock ailments in the Kingdom of Saudi Arabia. African Journal of Biotechnology, 10(45), 9153–9159. https://doi.org/10.5897/ajb10.1570

Smith, O. B., Olaloku, E. A., Smith', O. B., and Olaloku2, E. A. (1998). Peri-urban livestock production systems in sub-saharan africa cities feeding people series report 24 peri-urban livestock production systems in sub-saharan africa.

Taylor, N., and Fraser, H. (2019). The Cow Project: Analytical and Representational Dilemmas of Dairy Farmers' Conceptions of Cruelty and Kindness. Animal Studies Journal, 8(2), 133–153. https://doi.org/10.14453/asj.v8i2.10

Terrestrial Code: OIE - World Organisation for Animal Health. (n.d.). Retrieved December 8, 2020, from https://www.oie.int/standard-setting/terrestrial-code/

Traoré, L., Yaro, V. S. O., Soudré, A., Ouédraogo-Koné, S., Ouédraogo, D., Yougbaré, B., Zoma, B. L., Hien, M., Guissou, M. L., Traoré, A., Mészáros, G., Wurzinger, M., Burger, P., Okeyo, A. M., Thiombiano, A., and Sölkner, J. (2020). Indigenous knowledge of veterinary medicinal plant use in cattle treatment in southwestern Burkina Faso (West Africa). South African Journal of Botany, 128, 189–199. https://doi.org/10.1016/j.sajb.2019.09.015

Van Laer, E., Moons, C. P. H., Ampe, B., Sonck, B., Vandaele, L., De Campeneere, S., and Tuyttens, F. A. M. (2015). Effect of summer conditions and shade on behavioural indicators of thermal discomfort in Holstein dairy and Belgian Blue beef cattle on pasture. https://doi.org/10.1017/S1751731115000804

Veasey, J. S. (2017). In pursuit of peak animal welfare; the need to prioritize the meaningful over the

measurable. Zoo Biology, 36(6), 413–425. https://doi.org/10.1002/zoo.21390

Wallach, A. D., Ramp, D., and O'Neill, A. J. (2017). Cattle mortality on a predator-friendly station in central Australia. Journal of Mammalogy, 98(1), 45–52. https://doi.org/10.1093/jmammal/gyw156

Wanzala, W., Zessin, K. H., Kyule, N. M., Baumann, M. P. O., Mathia, E., and Hassanali, A. (2005). Ethnoveterinary medicine: a critical review of its evolution, perception, understanding and the way forward. http://localhost:8080/xmlui/handle/123456789/6887

Water Resources and Livestock: An increasing constraint. (2021). Retrieved March 19, 2021, from http://www-naweb.iaea.org/na/news-na/na-water-resources-livestock.html

Woods, A. (2012). From cruelty to welfare: The emergence of farm animal welfare in Britain, 1964-71. In Endeavour (Vol. 36, Issue 1, pp. 14–22). Elsevier Current Trends. https://doi.org/10.1016/j.endeavour.2011.10.003

Zulkifli, I. (2013). Review of human-animal interactions and their impact on animal productivity and welfare. Journal of Animal Science and Biotechnology 2013 4:1, 4(1), 1–7. https://doi.org/10.1186/2049-1891-4-25