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Cattle welfare aspects of production systems in the tropics

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ABSTRACT

There is a growing demand for animal products, especially food for human consumption, including in developing countries in tropical regions of the world. Simultaneously, animal welfare and a reduced environmental impact are increasingly important to modern consumers and non-consumers. Increased efficiency of existing animal production systems is key to meeting the growing demand of animal products without ignoring societal concerns. Adequate animal welfare can play an important role in improving production and addressing consumer demands. This review describes the main cattle production systems in the tropics and considers how they meet the need for transparent animal welfare conditions. Several challenges to overcome are highlighted, including lack of information about the real cattle welfare status in the tropics. Adequate assessment protocols and improvements in animal nutrition, infrastructure, animal health and farming-related education need special attention in the region. Better animal welfare could improve tropical animal production in terms of productivity, and increase the volume of meat and milk delivered. It could also guarantee consumer acceptance and future consumption of animal products, secure incomes, alleviate poverty and reduce migration to urban areas and countryside abandonment.

Keywords: animal welfare, beef, *Bos indicus*, cow, dairy, developing countries, subsistence farming, welfare assessment.

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Introduction

According to the Purchasing Power Parities and the Size of World Economies report from the World Bank (World Bank 2020), low- and middle-income economies account for half of the global economy. As the purchasing power increases, consumers become more aware of the properties of the products they buy, and their origin, demanding better welfare conditions for production animals and, in some cases, are willing to pay a higher price if animal welfare is guaranteed (Vargas-Bello-Pérez *et al.* 2017; Wang *et al.* 2018). Concerns about farmed animal welfare have led to the creation of organisations whose main objective is to prevent cruelty to animals, including those intended for human consumption, creating awareness about the fair treatment of animals during their entire lifetime. As informed and engaged consumers require verification of actual animal welfare levels, research is needed to properly assess animal welfare issues and provide useful tools to improve the lives of farmed animals, consumer knowledge, and the profitability of farming enterprises, especially under specific climatic conditions, such as the tropics.

During the past decades, there has been a surge on the discussion related to livestock production and its environmental impact, both contributing and being affected by climate change (Houghton *et al.* 2001; Pelletier and Tyedmers 2010; Rust 2019). The livestock sector is claimed to be responsible for about 14.5% of the global anthropogenic greenhouse-gas emissions, aside from requiring many natural resources (Grossi *et al.* 2019). Despite these concerns, there is an increasing demand for animal products, especially food for human consumption. The standard of living has increased in many countries, and modern trade agreements, combined with an ongoing globalisation process within agriculture, have increased the accessibility to meat products (Henchion *et al.* 2014). Additionally, the population in developing countries is continuing to grow

the season (Masike 2007). However, it is important to note that overgrazing of certain areas could increase by boreholes, as animals would remain together in a limited space close to the water (Dunne *et al.* 2011).

Infrastructure and handling facilities

Depending on the size and type of the farm enterprise, handling facilities and shelters with different levels of technification will be available. Cattle in pasture-based systems rest on the ground, not inside buildings as they do in temperate areas. Soil is an excellent surface to lie on, as long as the soil is dry and stones or thorns are not present. Depending on the country, cattle are kept in enclosures to protect them from being stolen and from natural predators at night. In some other tropical areas, they always rest outside, where shelters are not available for animals to protect themselves from the weather elements. This may lead to heat stress in the hottest months or health-related problems during the coldest season (Tucker *et al.* 2007). The lack of shade on grazing fields, particularly trees or constructed shelters, is a serious threat to animal welfare in hot climates (Silanikove 2000). The onset of the rainy season brings short fresh grass with high protein and low fibre, leading to diarrhoea in cattle ingesting this forage. The combination of cold and wet weather with this short, rich grass may weaken cattle and make them prone to diseases. Options to prevent this are providing shelter and limiting access to pasture or planting trees and shrubs in grazing areas.

Health and disease

A good health status is crucial for the productivity and welfare of animals. During recent decades, the importance of the link between the health of livestock and the health of humans has been increasingly emphasised, and the concept of 'One Health' has been expanded to also include wildlife health and ecosystem health (Gibbs 2014; Lerner and Berg 2015; Lerner and Berg 2017). This is certainly relevant also in a tropical setting, where cattle are kept on pasture and, hence, are an integrated part of the local environment, for example, in relation to exposure to vector borne diseases as mentioned below, and as potential contributors of transmissible diseases to the local wildlife. Grazing cattle are regarded as an important factor for maintaining certain types of flora and small fauna biodiversity, especially in the non-abundance of wild grazing ungulates, and such biodiversity is a relevant part of the One Health approach (Romanelli *et al.* 2014). Furthermore, a concept known as 'One Welfare' has been developed recently, drawing the attention to the fact that the welfare of the animals is closely linked to the welfare of the farmer (García Pinillos *et al.* 2016). If the farmer is confident and making a reasonable living from farming, this increases the chances of good animal management. Similarly, if the animals are sick, emaciated, injured or for other reasons not producing according to standard, this will negatively influence the welfare of the farmer.

In this specific context, various natural elements in the tropics can cause injuries and skin damage. Some of these elements are plant-based, especially thorns on trees or lying on the ground. Others are sharp stones, fighting with con-species, predator attacks and external parasites. These injuries might be very small initially but could easily become infected and cause great suffering.

The incidence of lameness in cows under grazing conditions in the tropics is estimated to be approximately 16% (Moreira *et al.* 2018) compared with a mean of 31.6% lame animals in England and Wales (Griffiths *et al.* 2018). Several factors could be responsible of this relatively low rate in the tropics, such as the low grain feed to the animals, soft grass decreasing pressure on the hoof, and a cleaner surface than pens in intensive production systems, thus reducing the incidence of hoof infections (Bruijnis *et al.* 2012). Compared with cattle in intensive production systems, the welfare and hoof health of cattle reared on grassland is generally better than those of European cattle housed indoors. However, while the numbers of foot lesions may be lower than in temperate intensive production systems, a high percentage of cattle in the tropics suffer impairments of the locomotive system that are frequently not detected and left untreated, becoming chronic problems that compromise animal welfare.

The hot, humid climate of the tropics also provides excellent living conditions for numerous parasites, including several potential vectors, and is favourable for the transmission of pathogens. Gastrointestinal nematodes can be considered one of the most important challenges in cattle production under tropical conditions as there is a high death rate due to parasitic infections and poor nutritional conditions (Molento *et al.* 2011). Ticks and tick-borne diseases, such as bovine babesiosis, east coast fever and anaplasmosis, have also been recognised as an emerging health problem due to growing resistance to acaricides, causing great economic losses (Nene *et al.* 2016; Almazan *et al.* 2018; Hernández-Castellano *et al.* 2019). If ticks appear in large quantities, they impair growth and productivity and cause other long-term problems, affecting animal metabolism and reproduction (O'Kelly *et al.* 1988). East coast fever, a parasitic disease transmitted among cattle or from buffaloes via a specific type of ticks, kills about 1 million heads of cattle in Africa every year (Gachohi *et al.* 2012; International Livestock Research Institute (ILRI) 2021). Farms in the tropics also often have a low level of biosecurity, limited possibilities for isolation of sick animals, and limited training and knowledge about disease prevention, making them vulnerable to infectious diseases (Hernández-Castellano *et al.* 2019).

A good start to improving cattle health and animal welfare conditions would be to focus on reducing disease incidence. Implementation of vaccination and preventive medicine programs can be cost-effective and reduce animal suffering in the long run. Another important action to decrease disease is the application of biosecurity protocols to animals and people entering the farm (Hernandez *et al.* 2017). Depending on the management of the herd, frequency of handling, and whether the animals are sheltered or not, farmworkers and farmers will be able to notice and treat wounds. When animals are kept outside and left by themselves, medical attention might not arrive on time, and sometimes a small problem can evolve into a significant issue, ending in a major infection or death. However, antibiotics, medicines to control parasites, and other drugs must be used carefully to avoid the development of resistance in bacteria and parasites. This is a major problem that is likely to continue in the future, particularly in tropical countries, since the use of veterinary drugs is unregulated in a great proportion of countries in the region. Changes in policy so that drugs can be used and applied only by certified veterinarians have to be put into place to prevent any further increase in antimicrobial and parasite resistance, which are current problems in developing countries (Grace 2015; Roess *et al.* 2015).

Animal welfare education in the tropics

The animal welfare situation in developing countries in the tropics is not optimal. Animal welfare is not a priority due to poverty and food insecurity, which, in turn, are accompanied by a lack of knowledge of animal behavior and inadequate livestock handling facilities. Moreover, traditional customs and beliefs can be detrimental to animal health (Ndou *et al.* 2011; Asebe *et al.* 2016). Animals are sometimes subjected to painful and stressful situations when they must be vaccinated, treated against disease, hot-iron branded, castrated or dehorned. These procedures can be extremely painful, generating fear that can lead to traumatisation and long-term stress, affecting productivity (Grandin *et al.* 1998). This is very harmful to the animal but also increases the difficulties in handling cattle. Treating the animals with a correct pain management strategy might help handle the animals in the future, saving time and money (Hudson *et al.* 2008).

Draft animals are in a different situation. Cattle can be used for pulling carts or plows with poorly adapted tools. They may pull heavy loads, get beaten when working, and must work or rest without shelter from the sun. Better equipment and better treatment of the animals would improve their welfare and performance (Petherick 2005). It is a challenge to change old habits such as beating animals, but once the farmer or worker understands that it is in their interest, they might behave differently. However, regulating draft animal welfare and improving their conditions is restricted by education and financial barriers (Ramaswamy 1994).

Moving animals from one place to another can be hazardous for their psychological and physical integrity due to long transport or waiting times, food and water restrictions, extreme weather and stressful and new environments (Fisher *et al.* 2009; Bulitta *et al.* 2012). If undertaken incorrectly, animals can be injured during transportation or die before arriving at their destination. The conditions in many slaughterhouses do not follow sanitary and food safety guidelines, having dirty surroundings, untrained personnel, and procedures that hurt animals before slaughter (Adeyemo *et al.* 2009). Killing methods can also be very painful. In many cases, the animals are not stunned (Adeyemo *et al.* 2009; Ahsan *et al.* 2014), sometimes because of lack of equipment or because it is not the tradition and sometimes for religious reasons, as many Muslim groups believe that pre-slaughter stunning is not Halal (Khaneghahi Abyaneh *et al.* 2020). In other cases, the stunning technique may be performed incorrectly, failing to render the animal unconscious and involving several attempts to stun the animal before it is slaughtered (Miranda-de la Lama *et al.* 2012). If the procedure is performed on the farm or in the village and is performed by the farmer, this might mean that there is no stress arising from the transportation, but methods used when killing the animals might still cause unnecessary suffering and stress. It is vital to raise awareness of animal welfare and work with the people involved in cattle farming and raising. Reducing transportation, loading, unloading and handling times are necessary to improve cattle welfare in markets and slaughterhouses. Training and education of abattoir workers are also needed, so they understand how to correctly manage, stun and slaughter animals without causing them suffering. This could be driven by governments through the implementation of rules concerning slaughter and transportation. These are urgently needed to improve cattle welfare in the tropics (Petherick 2005; Njisane *et al.* 2020).

Heat stress

The hot and humid climate in tropical regions puts high pressure on animals. In these conditions, the inherent capability of cattle to cool down by sweating and panting is compromised, and heat stress easily occurs. In temperatures above 28°C, even without humid conditions, lactating cows show signs of emerging heat stress (West 2003; Avendaño-Reyes 2012). As pointed out by Silanikove (2000) in an interesting review about the effect of heat stress on animal welfare, despite ruminants having a well developed thermoregulation mechanism, they do not maintain strict homeothermy under heat stress. According to Silanikove (2000), there is unequivocal evidence that hyperthermia is deleterious to any form of productivity, regardless of breed

and adaptation stage to the environment. Heat stress is also regarded as a risk factor for increased susceptibility to disease due to the negative impact on the immune system (Bagath *et al.* 2019). How to grade the welfare of the animals affected by heat stress under the current welfare protocols remains an issue for discussion. Cows with elevated body temperature limit their dry-matter feed intake, and thus milk yield is reduced (West 2003). Heat stress is also reported to alter the affective state of cattle, inducing feelings of hunger and thirst that could be related to feelings of frustration, aggression and pain (Polsky and von Keyserlingk 2017). Heat stress also harms reproductive performance (Jordan 2003) and the immune system (Bagath *et al.* 2019). Under extreme heat stress, animals may even die, especially calves (Stull *et al.* 2008).

The main factor responsible for heat stress in cattle is direct solar radiation; so, the animals seek shade when in hot temperatures (Kamal *et al.* 2018). The degree to which cattle are vulnerable to heat stress depends on various factors. For example, European breeds are often more affected (Hansen 2004). Also, the higher the milk yield, the more heat is produced during the lactation period. Hence, a high-yielding dairy cow is more vulnerable to heat stress and, at the same time, also needs more water to produce a larger amount of milk (Avendaño-Reyes 2012). Providing shade during the hot season is, therefore, an important animal welfare measure. Natural shade from trees is considered highly effective and can provide a microclimate for cattle since the trees reduce temperature and protect from solar radiation (Broom *et al.* 2013; Améndola *et al.* 2016). Trees can confer protection from harsh drying winds. The use of native trees and shrubs in pastures is proposed as a key element in enhancing ecosystem services in tropical pastoral landscapes (Murgueitio *et al.* 2011). Other methods to help cattle dissipate heat can be provided, such creating water baths for their immersion or showers, which is sometimes preferred by some individuals and breeds (Geraldo *et al.* 2012).

Animals often spend the night in enclosures to be protected from predators and thieves. Depending on the distance, when animals arrive to the pasture the next morning, the temperature can be already very hot, making grazing uncomfortable for them. Moving the shelter temporally to the grazing area may improve both animal welfare and production (Ol Pejeta Conservancy 2021).

Nardone *et al.* (2010) discuss possible effects on cattle production raised under tropical settings by arguing that climate change, under more severe conditions, will exacerbate issues such as lack of water in countries with high ambient temperatures, affecting livestock performance. They concluded that there is a need for better information concerning biophysical and social vulnerability, and these matters must be integrated with agriculture and livestock components.

Tropical cattle breeds

For decades, the tendency has been to improve the performance of tropical cattle with European breeds. However, this policy has resulted in animals being more susceptible to the environment and diseases. Increased concerns over chemical residues in food for human consumption, drug resistance and animal welfare are encouraging a change in the methods used to raise animals (Shyma *et al.* 2015). Rearing hardy breeds, more adapted to the conditions of the tropics, can have several benefits, as animals would be less susceptible to heat, parasites and other infections. For example, there is a consensus that Zebu cattle have greater tick resistance than do European or African cattle (Madalena *et al.* 1990; Frisch and O'Neill 1998; Mwangi *et al.* 1998; da Silva *et al.* 2007); therefore, the use of Zebu breeds in areas where ticks are a problem could improve animal welfare and, additionally, reduce the use of chemicals. Nevertheless, Zebu cattle, as well as many of the breeds adapted to the conditions of the tropics, typically manifest a lower performance than do European cattle. Therefore, a controlled cross-breeding should not be completely discarded. A better understanding of the genetic resistance to environmental factors and diseases of tropical breeds could help create breeding strategies to reach a balance between productivity and resistance without jeopardising animal welfare and sustainability.

Conclusions

So as to meet the new challenges and goals of sustainability, there is a global need to improve cattle production within existing herds and pasture provision. Large proportions of consumers and animal production occur in tropical regions of the world, creating a need to address the special conditions in which farming occurs in this region. Improved animal welfare is an increasingly important societal and consumer concern and can also be a way to improve productivity. However, there are several challenges to overcome, including a lack of information about cattle's real welfare status in the tropics. Tropical farming is performed under different management systems, depending on the climate, availability of resources and topography. However, the dominant system in terms of land usage and employment is still subsistence farming, which is largely pasture-based. There is a need for standardised animal welfare assessment protocols for animals in subsistence pasture-based systems, considering the particular conditions of extensive farming.

Additionally, aspects such as animal nutrition, adequate infrastructure, animal health and farming-related education need special attention in the region. Grassland management could be an easy measure to implement, but pasture quality

and water availability vary depending on the geographical area. Access to water might not be an easy issue to solve, so further solutions are needed. The education of farmers on animal welfare could prioritise and improve infrastructure, disease prevention and animal management. Better animal welfare could improve production in terms of volume and guarantee consumer acceptance and future animal product consumption. This would help secure incomes and alleviate poverty and abandonment of primary production.

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