Review Article

The Link Between Animal Welfare and Sustainable Development: Lessons for Somalia. A Review Article

Abdiaziz Idiris Mohamud[1,2]*, Yonis Abukar Mohamed[1,3] and Shafii Abdullahi Mohamed[1,4]

[1]Somali Animal Welfare Society (SAWS), Mogadishu, Somalia; [2]Department of Medicine, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh–2202, Bangladesh; [3]Faculty of Veterinary Science, Benadir University, Mogadishu, Somalia; [4]Faculty of Veterinary Medicine and animal Husbandry, Somali National University, Mogadishu, Somalia.

Abstract | This study explores the importance of integrating animal welfare into Somalia's sustainable development strategies. The interconnectedness of animal welfare, livelihoods, and environmental sustainability is highlighted, emphasizing the need for comprehensive approaches. Stakeholder engagement, partnerships, and capacity-building initiatives are crucial for effective collaboration and resource optimization. Addressing research gaps, including socio-economic impact assessments, intervention effectiveness evaluations, cultural and contextual considerations, analysis of different production systems, and exploration of the intersection of animal welfare and zoonotic disease prevention, is necessary for evidence-based decision-making. By leveraging research, promoting evidence-based interventions, and strengthening policy and governance frameworks, Somalia can enhance animal welfare, support sustainable livelihoods, and contribute to overall sustainable development in the country. The integration of animal welfare into Somalia's sustainable development agenda will not only benefit animal well-being but also foster resilient livestock systems, preserve cultural practices, and also contributing to global efforts to create a more equitable and compassionate world.

Introduction

Animal welfare, encompassing the well-being and ethical treatment of animals, has gained increasing recognition as a crucial element of sustainable development (Fraser, 2008; Mellor *et al.*, 2009; Dawkins, 2021). Animals contribute to various dimensions of human life, including food security, livelihoods, biodiversity conservation, and cultural heritage. As societies strive for holistic progress, ensuring the welfare of animals becomes imperative to achieve sustainable development goals (Steinfeld *et al.*, 2006; Thornton *et al.*, 2009).

Livestock rearing, an integral part of the Somali economy, supports the livelihoods of many

communities. Somalia's livestock sector contributes significantly to national income, food production, and export revenues. Therefore, understanding the link between animal welfare and sustainable development is paramount importance in Somalia.

According to Catley et al. (2013), livestock plays a critical role in poverty reduction and resilience-building in pastoralist communities. Enhancing animal welfare not only improves production efficiency but also helps mitigate the negative impacts of climate change on livestock systems (Cattaneo, 2018). Furthermore, addressing animal welfare concerns aligns with the United Nations' Sustainable Development Goals (SDGs), including Goal 1, "No Poverty," recognizes the importance of livestock and animals in poverty reduction and livelihoods, emphasizing the need to ensure the welfare of animals that contribute to people's well-being (Olmos et al., 2021).

Goal 2, "Zero Hunger," acknowledges the crucial role of animals in food production and calls for sustainable agricultural practices that promote animal welfare throughout the value (Björkbom, 2023).

Goal 3, "Good Health and Well-being," includes considerations for animal welfare as it promotes the humane treatment of animals for research, healthcare, and livestock farming practices to safeguard both human and animal health (Keeling et al., 2022).

Goal 12, "Responsible Consumption and Production," highlights the importance of sustainable livestock production and responsible consumption of animal products, encouraging practices that prioritize the welfare of animals throughout their lives (Keeling et., 2019).

Goal 15, "Life on Land," emphasizes the conservation and sustainable use of terrestrial ecosystems, recognizing the intrinsic value of animals and their habitats and promoting their welfare and protection (Sartore-Baldwin, 2022).

It is vital for Somalia's sustainable development to incorporate animal welfare considerations into the Sustainable Development Goals (SDGs). By integrating animal welfare considerations into these goals, Somalia can strive for a more holistic and sustainable development approach. Recognizing these

links enables Somalia to pursue a comprehensive strategy that integrates the welfare of animals, promoting their well-being alongside societal progress. Therefore, the objective of this article is to delve into the profound significance of animal welfare in Somalia's sustainable development. By addressing this objective, this review article aims to provide a comprehensive overview of the link between animal welfare and sustainable development, with a specific focus on Somalia. It serves as a valuable resource for policymakers, researchers, and practitioners seeking to promote ethical and sustainable practices that benefit both animals and communities in Somali.

Animal welfare and sustainable development: Conceptual framework

Animal welfare and sustainable development are interconnected concepts that play a crucial role in shaping a more equitable and environmentally conscious world. This conceptual framework aims to explore the relationship between animal welfare and sustainable development goals by first defining animal welfare and its multidimensional aspects (Ghislain, 2022; Cox, 2023). Subsequently, it will delve into the linkages between animal welfare and key sustainable development goals, highlighting how promoting animal welfare contributes to the achievement of broader sustainable development objectives (Steinfeld et al., 2006; Thornton et al., 2009).

Figure 1: *Animal welfare and the United Nations' sustainable development goals.*
Source: *UN's SDGs.*

Defining animal welfare and its multidimensional aspects

Animal welfare refers to the well-being of animals, encompassing their physical, mental, and emotional states. It involves ensuring that animals are treated

with compassion, respect, and dignity, and that their fundamental needs are met (Fraser, 2008; Perino and Schwickert, 2023). Understanding the multidimensional aspects of animal welfare is essential for comprehending the complex nature of this concept. Animal welfare can be examined through various dimensions, including the provision of proper nutrition, access to adequate shelter and healthcare, and the ability to express natural behaviors (McDowall *et al*., 2023; Parlasca *et al*., 2023). Fraser (2008) discusses the five freedoms, a widely recognized framework for animal welfare, which includes freedom from hunger and thirst, freedom from discomfort, freedom from pain, injury, or disease, freedom to express normal behavior, and freedom from fear and distress.

Linkages between animal welfare and sustainable development goals

The connection between animal welfare and sustainable development goals is crucial for fostering a harmonious relationship between humans, animals, and the environment. Animals play a vital role in sustainable development by contributing to poverty reduction, food security, environmental conservation, and social well-being (Rawles *et al*., 2012). For instance, animals in agriculture provide essential resources such as food, fiber, and draught power, which contribute to poverty reduction and food security (Sansoucy, 2023). Livestock farming can also contribute to sustainable land management and ecosystem services, including nutrient cycling and biodiversity conservation (Herrero *et al*., 2009). Additionally, animals have a significant impact on social well-being, as they provide companionship, support therapy, and contribute to cultural and recreational activities (Thornton *et al*., 2009).

Recognizing the interdependence between animal welfare and sustainable development goals is essential for developing integrated approaches that promote both animal well-being and broader sustainable development. By prioritizing animal welfare, societies can achieve sustainable development in a more holistic and inclusive manner.

This conceptual framework emphasizes the close relationship between animal welfare and sustainable development goals. By defining animal welfare and its multidimensional aspects, we gain a deeper understanding of the comprehensive needs and well-being of animals (Fraser, 2008; Olmos *et al*., 2021).

Furthermore, by exploring the linkages between animal welfare and sustainable development, we recognize the contributions of animals to poverty reduction, food security, environmental conservation, and social well-being (Steinfeld *et al*., 2006; Thornton *et al*., 2009).

Integrating animal welfare considerations into sustainable development practices ensures a more ethical, equitable, and environmentally sustainable future. By prioritizing animal welfare, we promote the well-being of animals while simultaneously advancing sustainable development goals. It is through this interconnected approach that we can create a more harmonious coexistence between humans, animals, and the environment.

Animal welfare challenges in Somalia

Socio-economic factors impacting animal welfare practices: Socio-economic factors play a significant role in shaping animal welfare practices in Somalia. The country faces numerous challenges, including widespread poverty, limited resources, and inadequate infrastructure, which directly impact the ability of livestock keepers to provide adequate care for their animals (Alinovi *et al*., 2007). Livestock represents a crucial source of livelihood for many communities in Somalia, and the well-being of these animals is intricately tied to the socio-economic conditions of their owners. Economic constraints often result in a lack of access to quality feed, clean water, and veterinary services, ultimately affecting the overall welfare of the animals.

Traditional beliefs and cultural considerations: Traditional beliefs and cultural practices also influence animal welfare in Somalia. The country has a rich cultural heritage with strong ties to livestock rearing and husbandry practices. However, some traditional customs and rituals may conflict with modern animal welfare principles. For example, certain husbandry practices, such as tail docking, tooth filing, or certain slaughter methods, may cause unnecessary pain and suffering to animals. It is essential to strike a balance between preserving cultural traditions and promoting animal welfare by raising awareness and engaging with communities to encourage alternative practices that align with welfare standards (Larrondo *et al*., 2018; Sutherland, 2015; Sutherland *et al*., 2011).

Animal health, disease control, and access to veterinary services: Ensuring good animal health is crucial for

promoting animal welfare in Somalia. However, the country faces challenges related to disease control and limited access to veterinary services. Infectious diseases pose a significant threat to livestock populations, impacting both their health and welfare. Outbreaks of diseases such as Rift Valley fever or contagious bovine pleuropneumonia can result in significant economic losses and animal suffering (Hassan-Kadle *et al.*, 2021; Mohamed *et al.*, 2021). Strengthening veterinary infrastructure, enhancing disease surveillance systems, and promoting vaccination campaigns are essential components in safeguarding animal health and improving welfare standards (Mohamud *et al.*, 2020; OIE, 2021a).

Livestock production systems and intensification: Livestock production systems in Somalia range from traditional extensive pastoralism to more intensive systems driven by market demands. However, the intensification of livestock production can raise concerns regarding animal welfare. Increased population pressure and market demands often lead to overcrowding, limited space, and inadequate housing conditions for animals (Ludwiczak *et al.*, 2021; Teresa *et al.*, 2019). These factors can compromise the welfare of livestock, including their ability to exhibit natural behaviors and access essential resources. Balancing the need for increased productivity with ethical and welfare considerations is crucial for promoting sustainable livestock development in Somalia (Sansoucy,1995).

Addressing the animal welfare challenges in Somalia requires a comprehensive approach that takes into account socio-economic factors, cultural sensitivities, animal health, and livestock production systems. Integrating animal welfare considerations into policies, regulations, and capacity-building initiatives is necessary to promote positive change and improve the well-being of animals. Collaboration between government entities, local communities, international organizations, and veterinary professionals can contribute to the development of effective strategies and interventions that enhance animal welfare while supporting sustainable development and resilience in the livestock sector.

Environmental implications of animal welfare

Biodiversity conservation and habitat preservation: Animal welfare practices have significant implications for biodiversity conservation and the preservation of natural habitats. The welfare of wildlife species is closely linked to the conservation of their habitats, as well as the maintenance of healthy ecosystems (Fraser, 2008; Mellor *et al.*, 2009). Implementing animal welfare measures that prioritize the protection and restoration of natural habitats can contribute to the conservation of diverse plant and animal species.

By providing appropriate habitat conditions, such as suitable vegetation, clean water sources, and adequate shelter, animal welfare practices can support the survival and reproduction of wildlife species (McBride *et al.*, 2022; Schmidt, 2011). Preserving natural habitats and promoting biodiversity not only ensures the well-being of wildlife but also benefits ecosystems by maintaining ecological balance, promoting pollination, and supporting nutrient cycling.

Climate change mitigation and adaptation: Animal welfare practices also have implications for climate change mitigation and adaptation strategies. Livestock production is a significant contributor to greenhouse gas emissions, primarily through enteric fermentation, manure management, and deforestation for pastureland (Gerber *et al.*, 2013; Shukla *et al.*, 2019). Implementing animal welfare measures that promote sustainable livestock production systems can help reduce the environmental footprint of the industry and mitigate climate change.

For instance, improving animal nutrition and health can enhance feed efficiency and reduce methane emissions from enteric fermentation (Herrero *et al.*, 2016). Additionally, adopting sustainable land management practices, such as rotational grazing and agroforestry, can enhance carbon sequestration, reduce soil erosion, and promote climate resilience (Mbow *et al.*, 2017).

Furthermore, animal welfare practices that focus on reducing the vulnerability of livestock to extreme weather events, such as heat stress, can contribute to climate change adaptation. Providing appropriate shelter, access to shade, and adequate water supply can help animals cope with the impacts of climate change and improve their overall welfare (Marai *et al.*, 2007; Polsky *et al.*, 2017).

Sustainable land and resource management: Animal welfare practices are closely intertwined with sustainable land and resource management. Livestock

production systems require vast land areas for grazing and fodder production, making the sustainable use of resources crucial (Gerber *et al.*, 2013; Branca *et al.*, 2013). Implementing animal welfare measures that promote efficient resource utilization and minimize environmental degradation can contribute to sustainable land management. For example, adopting practices such as rotational grazing, which allows for natural pasture regeneration, helps prevent overgrazing and soil degradation (Kotzé *et al.*, 2013). Efficient water management, including the use of water-conserving techniques and proper waste management, reduces water pollution and promotes water resource sustainability (Rojas-Downing *et al.*, 2017; Strauch *et al.*, 2009).

Furthermore, integrating livestock production with agroforestry systems can enhance resource efficiency by utilizing trees for fodder, shade, and soil conservation purposes (Mekonnen *et al.*, 2012; Kumar and Singh, 2016). By optimizing land and resource use, animal welfare practices contribute to long-term environmental sustainability while ensuring the well-being of animals.

Animal welfare policies and legislation

Existing frameworks and their adequacy: Animal welfare policies and legislation form the foundation for ensuring the well-being of animals and promoting responsible animal care practices. The adequacy of existing frameworks varies across countries and regions, with some jurisdictions having well-established legal frameworks, while others may have limited or fragmented regulations (Croney and Millman, 2007; Horgan and Gavinelli, 2006).

In many countries, animal welfare legislation is influenced by international agreements and conventions, such as the World Organization for Animal Health (OIE) standards and guidelines (OIE, 2021b). These frameworks provide a basis for addressing key aspects of animal welfare, including animal housing, transportation, slaughter, and the prevention of cruelty. However, the effectiveness of existing frameworks depends on various factors, including their enforceability, the level of public awareness and compliance, and the availability of resources for implementation and enforcement (Vapnek and Chapman, 2010). Evaluating the adequacy of animal welfare frameworks involves considering their alignment with scientific knowledge,

societal expectations, and the evolving understanding of animal welfare as a multidimensional concept.

International guidelines and best practices: International organizations and bodies provide guidelines and best practices to assist countries in developing and improving their animal welfare policies and legislation, for example, offering guidance on various topics, such as farm animal welfare, wildlife protection, and the welfare of animals in disasters. These guidelines draw on scientific research, practical experience, and ethical considerations to promote high standards of animal welfare.

Additionally, the OIE sets international standards for animal welfare that member countries are encouraged to incorporate into their national legislation (OIE, 2021).

These standards cover a wide range of animal species and address issues such as housing, transportation, humane slaughter, and the control of animal diseases.

Best practices from countries with well-developed animal welfare frameworks can serve as models for policy improvements. Examples include countries like Denmark, Norway, New Zealand, and the United Kingdom, which have comprehensive animal welfare legislation, effective enforcement mechanisms, and public awareness campaigns (Walker-Munro, 2015; Nielsen *et al.*, 2017; Manning *et al.*, 2021). Analyzing successful case studies and benchmarking against international best practices can provide insights into areas for improvement and guide policy development in Somalia.

Opportunities for policy improvements in Somalia: In Somalia, there are opportunities for enhancing animal welfare policies and legislation to ensure the well-being of animals and align with sustainable development goals. Considerations for policy improvements should take into account the unique socio-economic, cultural, and environmental context of the country.

Strengthening legislation: Enhancing existing animal welfare legislation in Somalia may involve enacting comprehensive laws that encompass various aspects of animal welfare, such as livestock care, transportation, and slaughter. This includes defining minimum welfare standards, establishing legal responsibilities

and penalties for non-compliance, and providing mechanisms for enforcement (Council, 2009; Rodriguez, 2022; Lundmark et al., 2021).

Capacity building: Building the capacity of relevant stakeholders, including veterinary professionals, animal welfare organizations, and law enforcement agencies, is crucial for effective implementation of animal welfare policies. Training programs, workshops, and awareness campaigns can help enhance understanding, compliance, and enforcement of animal welfare standards (Caporale et al., 2005; Sinclair et al., 2017; Escobar et al., 2018).

Collaboration and partnerships: Collaborative efforts among government agencies, non-governmental organizations, and international partners can facilitate the development and implementation of animal welfare policies in Somalia. Collaboration can involve sharing knowledge, expertise, and resources to improve the legal framework, promote public awareness, and strengthen enforcement mechanisms (Imperial, 2005; Akhtar-Schuster et al., 2011). Engaging local communities, traditional leaders, and livestock producers in the policy-making process can help ensure that animal welfare practices are culturally appropriate and acceptable (Union, 2013; Cooney et al., 2018). It is important to foster dialogue, build trust, and involve all relevant stakeholders in shaping animal welfare policies and legislation.

Research and data collection: Conducting research and gathering data on animal welfare conditions in Somalia can provide a solid evidence base for policy development and improvement. This includes studying the welfare needs of different animal species, assessing the impact of existing practices on animal well-being, and identifying areas where interventions are needed. Research findings can inform the formulation of evidence-based policies and help evaluate the effectiveness of interventions.

Public awareness and education: Raising public awareness about animal welfare is crucial for generating support and promoting responsible animal care practices. Educational campaigns, outreach programs, and school curricula can play a vital role in fostering a culture of compassion and empathy towards animals (Faver, 2010; Young et al., 2018). Public engagement efforts can also involve promoting alternative livelihood options that are compatible with

animal welfare principles, thereby addressing socio-economic factors that may impact animal welfare practices.

Continuous evaluation and monitoring: Regular evaluation and monitoring of animal welfare policies and legislation are essential to ensure their effectiveness and identify areas for improvement. This can involve conducting periodic assessments, audits, and inspections of livestock facilities, transportation systems, and slaughterhouses to ensure compliance with established standards. Monitoring mechanisms can also include the establishment of reporting systems for animal welfare violations and the collection of data on enforcement activities.

Enhancing animal welfare policies and legislation in Somalia requires a multi-faceted approach that considers the existing frameworks, international guidelines, and best practices. It also involves addressing the specific challenges and opportunities within the socio-economic, cultural, and environmental context of the country. By strengthening legislation, building capacity, fostering collaboration, conducting research, raising public awareness, and ensuring continuous evaluation, Somalia can make significant strides towards improving animal welfare and aligning with sustainable development goals.

Economic advantages derived from animal welfare practices

Animal welfare practices not only contribute to ethical and moral considerations but also offer significant economic benefits. This section explores the various dimensions of economic advantages associated with animal welfare. The discussion will focus on three key aspects: enhanced productivity and profitability, market access and trade opportunities, and economic diversification and job creation.

Enhanced productivity and profitability: Animal welfare practices positively impact productivity and profitability in various sectors. Studies have shown that providing appropriate housing, nutrition, and healthcare for animals leads to improved reproductive performance, reduced mortality rates, and enhanced growth rates (Fernandes et al., 2021; Temple and Manteca, 2020; Sinclair al., 2019). For instance, research conducted in the dairy industry revealed that farms implementing better welfare practices experienced increased milk yields and improved overall farm profitability (Hen-

chion *et al.*, 2022). These findings emphasize the economic value of investing in animal welfare measures to optimize production efficiency.

Market access and trade opportunities: The importance of animal welfare in consumer preferences and market demand cannot be underestimated. Consumers are increasingly conscious of animal welfare standards and are willing to pay a premium for products derived from ethically treated animals (Napolitano *et al.*, 2010). Studies have indicated that animal welfare certification and labeling positively influence consumer choices and enhance market access (Ingenbleek et al., 2012; Dutch Government, 2022; Ingenbleek and Krampe, 2022). Furthermore, adherence to robust animal welfare regulations facilitates international trade by meeting import requirements and establishing credibility in global markets (Thiermann and Babcock, 2005; Bowles *et al.*, 2005). Access to premium markets, both domestic and international, offers economic advantages to producers committed to high animal welfare standards.

Economic diversification and job creation: The integration of animal welfare practices in agricultural and related industries can contribute to economic diversification and job creation. Developing and implementing animal welfare initiatives require specialized knowledge, expertise, and supportive infrastructure, resulting in the emergence of new job opportunities in areas such as animal welfare auditing, certification, and training (Rushen *et al.*, 2011). Furthermore, promoting animal welfare can drive innovation and stimulate the growth of new industries, such as the production of alternative animal products and the development of technologies and services for monitoring animal well-being (Sinclair *et al.*, 2019). These developments contribute to overall economic diversification and the creation of sustainable employment opportunities.

The economic benefits derived from animal welfare practices are significant and wide-ranging. Enhancing productivity and profitability, gaining market access and trade opportunities, and fostering economic diversification and job creation are pivotal outcomes of prioritizing animal welfare. These findings highlight the potential for aligning ethical considerations with economic gains, making animal welfare a crucial aspect of sustainable and profitable agricultural systems.

Sociocultural considerations in animal welfare and sustainable development

Balancing traditional practices with modern welfare standards: In many societies, traditional practices and cultural norms have a significant influence on animal welfare practices. Balancing these traditions with modern welfare standards requires a nuanced approach that respects cultural heritage while promoting the well-being of animals. This can be achieved by engaging with local communities, religious leaders, and cultural authorities to foster understanding and awareness of animal welfare principles. Collaborative efforts can focus on adapting traditional practices to align with modern standards, such as improving housing conditions, handling practices, and transportation methods (Szűcs *et al.*, 2019; Qekwana *et al.*, 2019). Building trust and establishing dialogue between stakeholders is essential for finding common ground and achieving a harmonious balance between tradition and welfare considerations.

Community engagement and education for behavioral change: Community engagement and education play a crucial role in promoting positive behavioral change towards animal welfare. By actively involving community members, such as farmers, herders, and local leaders, in educational programs and awareness campaigns, the understanding and acceptance of animal welfare practices can be enhanced. This can be achieved through community workshops, training sessions, and the dissemination of educational materials that highlight the benefits of animal welfare and provide practical guidance on improving animal care (Qekwana *et al.*, 2019). Collaborative initiatives involving local NGOs, extension services, and veterinary professionals can support community engagement efforts and provide expertise in delivering culturally relevant and context-specific information (McDavid *et al.*, 2021). Moreover, social marketing techniques, storytelling, and the involvement of opinion leaders can help effectively communicate the importance of animal welfare and inspire behavioral change within communities.

Lessons for Somalia regarding to animal welfare and sustainable development goals

The link between animal welfare and sustainable development goals has been extensively studied, providing valuable insights for Somalia's development agenda. By recognizing the importance of animal welfare and integrating it into sustainable development

efforts, Somalia can achieve multiple goals while promoting the well-being of animals, communities, and ecosystems. Drawing upon the review of literature, the following lessons can be derived.

Enhancing food security and nutrition: Integrating animal welfare practices improves food security and nutrition by enhancing animal health and the quality of animal products. Implementing animal welfare practices in Somalia can lead to better animal health, reducing the risk of diseases and infections. Healthy animals produce higher-quality products, contributing to food security and nutrition. Ensuring animal welfare promotes good health, resulting in improved productivity and reduced disease incidence (Sinclair et al., 2019). By providing appropriate housing, nutrition, and veterinary care, animal welfare practices can prevent the spread of diseases and reduce the need for antibiotics (Albernaz-Gonçalves et al., 2022). Animal welfare practices are often aligned with sustainable livestock production systems. These systems promote responsible resource management, reduce environmental impact, and ensure long-term food security.

Animal welfare is an essential component of sustainable livestock production. It emphasizes that good animal welfare practices contribute to efficient and sustainable animal production, which is crucial for global food security (Temple and Manteca, 2020). By integrating animal welfare practices into livestock production systems, we can enhance animal health, improve the quality of animal products, meet consumer demand, and ensure sustainable food security in Somalia.

Strengthening livelihoods and economic growth: Supporting animal welfare measures in livestock systems can have significant benefits for both farmers and economies. By implementing animal welfare practices, livestock productivity can be improved, leading to increased income for farmers and improved livelihoods (Sinclair et al., 2019; Fernandes et al., 2021).

Furthermore, animal welfare practices can enhance the market value of animal products. By improving the quality, safety, and consumer perception of these products, consumers may be willing to pay a premium for animal products produced under higher animal welfare standards (Thompson et al., 2009; Napolitano, 2010).

Beyond the direct economic benefits, promoting animal welfare can contribute to poverty reduction and economic growth. Livestock ownership and productivity are often vital sources of income for rural households in many countries. Improved animal welfare practices, along with other factors, can positively influence livestock productivity, generating higher incomes for households and contributing to poverty reduction (Moyo et al., 2010; Sinclair et al., 2019).

In regions where livestock plays a significant role in the economy and livelihoods of communities, supporting animal welfare measures can stimulate economic growth by creating employment opportunities and fostering sustainable agricultural systems (Moyo et al., 2010; Herrero et al., 2013). This is particularly relevant in countries like Somalia, where livestock holds immense importance for the economy and the livelihoods of many communities (Nori et al., 2016; Maundu et al., 2019; Mahmoud, 2010). By investing in animal welfare practices, Somalia can harness the potential of its livestock sector to reduce poverty, generate income, and promote sustainable economic development.

Overall, prioritizing animal welfare measures in Somalia and other livestock-dependent regions is not only ethically crucial but also economically beneficial. It supports livelihoods, increases farmers' incomes, enhances the market value of animal products, and contributes to poverty reduction and economic growth in these communities.

Protecting biodiversity and ecosystems: Implementing animal welfare measures is vital for conserving endangered species, preserving ecosystems, and maintaining ecological balance. Animal welfare practices contribute to the protection of biodiversity by ensuring the well-being and survival of species within their habitats (Björkbom, 2023). By minimizing stress, providing suitable habitats, and promoting natural behaviors, animal welfare measures help maintain the integrity of ecosystems and prevent disturbances that can negatively impact biodiversity (Glenny et al., 2022). Moreover, animal welfare considerations also extend to captive breeding programs, which play a crucial role in conserving endangered species and restoring their populations (Conde et al., 2013).

In Somalia, where wildlife and biodiversity are of significant ecological importance, ensuring animal

welfare contributes to the conservation of unique species and habitats. By safeguarding the welfare of wildlife, particularly endangered and vulnerable species like the Somali wild ass and the Hirola antelope (Wamukoya, 2013; Muneza *et al.*, 2018), animal welfare practices indirectly protect the ecosystems they inhabit. A balanced and healthy ecosystem supports the resilience of local communities by providing ecosystem services, such as clean water, fertile soil, and climate regulation, which are essential for sustainable agricultural practices and human well-being.

Promoting health and well-being: Ensuring good animal health and well-being reduces the risk of zoonotic diseases, contributing to improved public health outcomes. In Somalia, where the majority of the population relies on livestock for sustenance and livelihoods, the health of animals is closely linked to the health and well-being of the local communities. By implementing animal welfare measures, such as proper nutrition, disease prevention, and veterinary care, the prevalence of zoonotic diseases can be minimized (Grace *et al.*, 2012). Controlling zoonotic diseases not only protects human health but also promotes food security by maintaining a healthy livestock population (MacKinnon *et al.*, 2023). Zoonotic diseases, such as brucellosis, tuberculosis, and Rift Valley fever, pose significant health risks in Somalia (Hassan-Kadle *et al.*, 2021; Mohamed *et al.*, 2021). These diseases can be transmitted from animals to humans through direct contact, consumption of contaminated animal products, or exposure to animal waste. By investing in animal health and welfare, Somalia can mitigate the transmission of zoonotic diseases by implementing vaccination programs, disease surveillance, and hygiene practices (Hassan-Kadle *et al.*, 2021). This not only protects human health but also reduces the economic burden associated with healthcare costs and lost productivity due to illness.

Animal-source foods are rich in essential nutrients, including high-quality proteins, vitamins, and minerals, which are necessary for growth, development, and overall health. However, the consumption of contaminated or low-quality animal products can pose health risks, leading to malnutrition and foodborne illnesses. By promoting animal health and welfare practices, Somalia can enhance the safety and quality of animal-source foods, ensuring that they contribute to improved nutrition and better health outcomes for the population.

Investing in veterinary services and capacity-building programs is crucial for supporting animal health and welfare in Somalia (Jesca *et al.*, 2016). Strengthening veterinary infrastructure, training veterinarians, and providing access to veterinary medicines and diagnostics are key components of ensuring good animal health. This not only benefits the animals themselves but also enhances public health and supports the livelihoods of livestock-dependent communities. Additionally, promoting community awareness and education on zoonotic diseases, hygiene practices, and responsible animal husbandry can empower communities to actively participate in safeguarding both human and animal health (Mohamud *et al.*, 2020; OIE, 2021). Therefore, investing in animal health and welfare in Somalia is essential for promoting the overall health and well-being of the population.

Ensuring ethical and responsible governance: Integrating animal welfare into governance frameworks fosters ethical practices in animal use, production, and management. In Somalia, where livestock plays a crucial role in the economy and livelihoods of many communities, ensuring ethical and responsible governance is essential. By incorporating animal welfare principles into legislation, regulations, and policies, Somalia can promote humane treatment, minimize animal suffering, and enhance the overall well-being of animals.

Ethical governance frameworks provide a legal and regulatory foundation for addressing animal welfare concerns. They establish standards and guidelines for animal husbandry, transportation, and slaughter practices (Smith, 2012). These frameworks can include provisions for appropriate housing conditions, access to clean water and nutritious food, veterinary care, and the prohibition of cruel practices. By enforcing and monitoring compliance with such regulations, Somalia can hold individuals and institutions accountable for their treatment of animals and ensure ethical practices are followed.

Integrating animal welfare into governance frameworks also encourages responsible animal management. This involves promoting sustainable practices that consider the long-term welfare and conservation of animal populations. For instance, measures such as implementing wildlife protection laws, managing

grazing lands sustainably, and regulating hunting and fishing activities can help preserve biodiversity and safeguard the habitats of native species (Smith, 2012). Responsible governance also extends to the prevention of illegal wildlife trade, which threatens both animal welfare and the integrity of ecosystems.

By prioritizing ethical governance and animal welfare, Somalia can enhance its reputation as a responsible member of the international community. Engaging in international collaborations, adopting best practices, and adhering to global standards in animal welfare governance can strengthen Somalia's position and contribute to the sustainable development of its livestock sector. Furthermore, ethical and responsible governance in animal use and production can improve market access for Somali animal products, both domestically and internationally, as consumers increasingly demand products that meet high animal welfare standards (Hall et al., 2004).

This additional highlight the importance of integrating animal welfare into governance frameworks to ensure ethical and responsible practices in animal use, production, and management in Somalia. By implementing and enforcing regulations, promoting responsible animal management, and engaging in international collaborations, Somalia can foster a culture of ethical governance, enhance animal welfare, and contribute to sustainable development in its livestock sector.

Strengthening environmental sustainability: Animal welfare practices, alongside sustainable farming methods, help minimize the environmental impact of livestock production and promote resource conservation. In Somalia, where livestock rearing is a significant component of the agricultural sector, integrating animal welfare practices into farming systems is crucial for sustainable and environmentally responsible livestock production. By ensuring proper animal nutrition, reducing stress, and implementing efficient waste management systems, animal welfare practices contribute to the reduction of environmental pollution and the conservation of natural resources (Herrero et al., 2015).

Livestock production, if not managed sustainably, can contribute to environmental degradation. However, by adopting sustainable farming methods such as agroforestry, rotational grazing, and water

conservation techniques, Somalia can mitigate the negative environmental impacts of livestock farming. Agroforestry systems, which involve integrating trees with pastureland, not only provide shade and forage for animals but also contribute to carbon sequestration and soil conservation, rotational grazing allows pastures to recover and prevents overgrazing, which can lead to soil erosion and the loss of biodiversity (Herrero et al., 2015). Additionally, implementing water conservation practices like rainwater harvesting and efficient irrigation systems can reduce water consumption and minimize the strain on local water resources (Chiu et al., 2020; Morales et al., 2021).

Efficient waste management is another aspect of animal welfare that contributes to environmental sustainability. Proper handling and treatment of animal waste, such as manure, can reduce the release of greenhouse gases and prevent water pollution. Implementing practices like composting and biogas production can help convert animal waste into valuable resources, such as organic fertilizers and renewable energy (Herrero et al., 2015).

By combining animal welfare practices with sustainable farming methods, Somalia can achieve a more harmonious balance between livestock production and environmental sustainability. This not only helps minimize the environmental footprint of the livestock sector but also promotes resource conservation, soil health, and biodiversity preservation. It contributes to the overall resilience of Somalia's agricultural systems and supports the long-term sustainability of livelihoods that depend on livestock.

Enhancing resilience and climate change adaptation: Integrating animal welfare into climate change adaptation strategies improves the adaptive capacity of livestock systems and promotes resilience. In Somalia, where climate change poses significant challenges to the agricultural sector, including increased frequency and intensity of droughts, integrating animal welfare practices into climate change adaptation measures is crucial. By ensuring the well-being of livestock, Somalia can enhance their ability to cope with climate-related stressors and maintain productivity in the face of changing environmental conditions.

Climate change affects livestock systems in multiple ways, including reduced forage availability, increased heat stress, and heightened disease risk. Integrating

animal welfare practices, such as providing access to shade, clean water, and nutritious feed, helps mitigate the negative impacts of climate change on livestock health and productivity (Thornton *et al.*, 2007, 2009). Proper shelter and shade provision can help animals regulate their body temperature, reducing the risk of heat stress, particularly during periods of extreme heat (Thornton *et al.*, 2009). Access to clean water sources is essential for hydration and preventing dehydration, particularly during droughts when water scarcity is a significant challenge (Akıncı and Lösel, 2012; Lusambili *et al.*, 2023). Additionally, ensuring a balanced and nutritious diet for livestock supports their immune system, reducing the susceptibility to diseases that can become more prevalent under changing climatic conditions (Thornton *et al.*, 2009).

Animal welfare practices that promote early disease detection and prompt veterinary care are also essential in climate change adaptation. As climate change may lead to the emergence or increased prevalence of certain diseases, implementing surveillance systems, vaccination programs, and appropriate disease management strategies can help mitigate disease outbreaks (Herrero *et al.*, 2016). Early detection and treatment can prevent the spread of diseases, protect livestock health, and safeguard the livelihoods of pastoralists and farmers in Somalia.

By integrating animal welfare into climate change adaptation strategies, Somalia can enhance the adaptive capacity of livestock systems and promote resilience. This includes providing training and education to livestock owners on climate-smart animal husbandry practices, promoting sustainable grazing management, and fostering partnerships between farmers, herders, and veterinary professionals (MacKinnon *et al.*, 2023). These measures empower livestock-dependent communities to adapt to changing climatic conditions and ensure the long-term viability of their livelihoods.

Fostering social cohesion and cultural preservation: Recognizing the cultural significance of animals and integrating animal welfare with cultural values fosters social cohesion and preserves cultural heritage. Livestock plays a central role in the cultural and social fabric of Somali society, serving as a source of livelihood, food, and a symbol of wealth and status (Mohamud *et al.*, 2020). By promoting animal welfare, Somalia can preserve its traditional cultural

practices, strengthen community bonds, and promote social cohesion.

Livestock rearing in Somalia is deeply intertwined with cultural traditions and customs. Nomadic pastoralism, in particular, is a way of life that has been practiced by Somali communities for centuries. It involves the movement of livestock herds across vast landscapes in search of grazing lands and water sources.

By integrating animal welfare practices into livestock management, Somalia can ensure the well-being and humane treatment of animals, aligning with the cultural values and traditions that emphasize respect for nature and animals. This includes providing adequate nutrition, access to water, shelter, and veterinary care for livestock. Respecting and preserving animal welfare contributes to the maintenance of traditional Somali values and promotes a sense of unity and harmony within communities (McGreevy, 2012).

Furthermore, practicing animal welfare not only fosters social cohesion but also enhances community cooperation and mutual support. Somali communities often engage in collective herding practices, where members of the community work together to manage and protect their livestock. By promoting animal welfare practices, such as rotational grazing and shared watering points, communities can enhance their collective resilience and adaptive capacity in the face of challenges like drought and environmental degradation (Herrero *et al.*, 2015). These practices not only sustain the well-being of animals but also strengthen community bonds and reinforce shared responsibilities.

Preserving cultural heritage is another important aspect of fostering social cohesion in Somalia. Animal husbandry, including traditional herding practices and the use of animal products in ceremonies and rituals, is deeply rooted in Somali culture. By integrating animal welfare practices, Somalia can ensure the sustainability and continuation of these cultural practices for future generations. This involves promoting the responsible use of animals, respecting their welfare, and engaging in sustainable practices that safeguard both the environment and cultural traditions (Kiper, 2013; Brown *et al.*, 2017).

Strengthening social justice and equity: Considering

animal welfare as part of development efforts promotes social justice and equity by ensuring fair treatment and equal opportunities for all living beings, including animals. In Somalia, where vulnerable populations rely heavily on livestock for their livelihoods, addressing animal welfare issues is essential for creating a more just and equitable society (Fraser, 2008; Fernandes et al., 2019).

Livestock represents a significant asset for many communities in Somalia, particularly among pastoralists and small-scale farmers. However, unequal access to resources and services, such as veterinary care, feed, and water, can lead to disparities and marginalization among livestock owners. By considering animal welfare as part of development efforts, Somalia can ensure fair treatment and equal opportunities for all livestock owners, irrespective of their socio-economic status or geographical location.

Addressing animal welfare concerns not only benefits the animals themselves but also has broader social and economic implications. Animals that are well cared for and free from unnecessary suffering are more likely to be productive, leading to improved livelihoods for their owners. Promoting access to veterinary services, education on proper animal husbandry practices, and fair market opportunities can help level the playing field and empower marginalized livestock owners to participate in and benefit from the livestock sector (Fraser, 2008; Vijayalakshmy et al., 2023; Herrero al., 2013).

Moreover, considering animal welfare aligns with the principles of social justice and equity by recognizing the intrinsic value of animals and their right to be treated with respect and compassion. This approach challenges the prevailing view of animals as mere commodities and emphasizes the importance of their well-being and ethical treatment. It also recognizes the interconnectedness between human well-being and animal welfare, as the mistreatment of animals can have adverse effects on human health, livelihoods, and the environment (Fraser and MacRae, 2011).

By incorporating animal welfare into development initiatives, Somalia can foster social justice and equity by promoting sustainable and responsible practices that benefit both animals and humans. This includes investing in capacity-building programs, establishing regulatory frameworks, and raising awareness about animal welfare rights and responsibilities. By empowering individuals and communities to uphold animal welfare standards, Somalia can create a more just and equitable society that values the well-being of all living beings.

Encouraging research and innovation: Investing in research and innovation in animal welfare practices and technologies can drive continuous improvement, sustainable solutions, and knowledge-sharing for animal welfare and development in Somalia. By prioritizing research and innovation, Somalia can enhance its understanding of animal welfare issues, identify effective interventions, and foster the development of context-specific solutions.

Research plays a crucial role in advancing animal welfare practices by generating evidence-based knowledge. Through rigorous scientific investigations, researchers can evaluate the impact of different interventions on animal well-being, assess the effectiveness of welfare standards, and identify areas for improvement. This knowledge is essential for designing and implementing evidence-based policies and practices that promote animal welfare in Somalia (Jirkof et al., 2019; Kwasny et al., 2022).

Investing in research also facilitates innovation in animal welfare technologies and practices. Through research and development, new tools, techniques, and approaches can be developed to enhance animal health, nutrition, and overall welfare. For example, innovations in housing systems, feeding practices, and veterinary care can contribute to improved animal well-being and productivity (Mellor, 2016; Temple and Manteca, 2020). By supporting research and innovation, Somalia can stay at the forefront of advancements in animal welfare, ensuring that its livestock sector remains sustainable, competitive, and humane.

Furthermore, research and innovation promote knowledge-sharing and collaboration among stakeholders. By fostering partnerships between academia, government agencies, non-governmental organizations, and local communities, valuable insights and experiences can be exchanged. This collaboration not only facilitates the dissemination of research findings but also enables the co-creation of knowledge and the development of practical solutions tailored to the specific needs of Somalia (Jull et al., 2017; Sjödin, 2019; Cornet and Barpanda, 2021).

Investments in research and innovation have the potential to drive systemic change in animal welfare practices. By building research capacity within Somalia, such as supporting local research institutions and providing training opportunities for researchers and practitioners, the country can develop a strong knowledge base and human capital in animal welfare. This, in turn, contributes to the continuous improvement of animal welfare standards, the adoption of sustainable practices, and the overall development of the livestock sector (Bozzo *et al.*, 2021). By considering these lessons, Somalia can further enhance its efforts to integrate animal welfare into its sustainable development agenda and create positive impacts on both human and animal well-being.

Opportunities for collaboration and capacity building

Stakeholder engagement and partnerships: Effective collaboration and engagement among stakeholders are crucial for promoting animal welfare and sustainable development in Somalia. Engaging government agencies, non-governmental organizations (NGOs), community-based organizations, and international partners can foster collective action and maximize resources. By establishing partnerships, sharing expertise, and leveraging diverse perspectives, stakeholders can work together to develop comprehensive strategies, policies, and programs for improving animal welfare (Fernandes *et al.*, 2019). Collaborative initiatives, such as joint training workshops, conferences, and working groups, can facilitate information exchange, coordination, and collaboration among stakeholders (Hang, 2018; Matzembacher *et al.*, 2021).

Training programs and knowledge sharing platforms: Capacity building through training programs and knowledge sharing platforms plays a vital role in enhancing animal welfare practices in Somalia. These initiatives provide opportunities for stakeholders, including veterinarians, livestock producers, and animal health workers, to acquire knowledge, skills, and best practices in animal welfare. Training programs can cover a wide range of topics, including animal handling, husbandry practices, disease prevention, and veterinary care (Zucker *et al.*, 2018; Fernandes *et al.*, 2019). Knowledge sharing platforms, such as online databases, workshops, and seminars, can facilitate the dissemination of information, research findings, and practical experiences to support evidence-based decision making and continuous learning.

Research gaps and future directions in Somalia: Identifying research gaps and setting future directions is essential for advancing animal welfare and sustainable development in Somalia. Research can provide evidence-based insights, generate innovative solutions, and inform policy and decision-making processes. Some key research areas that require attention include.

Socio-economic impact assessment: Conducting comprehensive studies to assess the socio-economic impact of animal welfare practices in Somalia is essential. This includes evaluating the economic benefits, livelihood implications, and social dynamics associated with improved animal welfare. Research should explore the linkages between animal welfare and poverty reduction, food security, and income generation, providing evidence to guide policy development and resource allocation.

Effectiveness of interventions: There is a need for rigorous evaluation of existing animal welfare interventions in Somalia to determine their effectiveness and identify areas for improvement. Research should focus on assessing the outcomes and impacts of various interventions, such as capacity building programs, training initiatives, and community engagement efforts, to ensure that resources are targeted towards strategies that yield positive animal welfare outcomes.

Cultural and contextual factors: Understanding the cultural and contextual factors that influence animal welfare outcomes is crucial for designing context-specific interventions. Research should explore the traditional beliefs, attitudes, and practices related to animal welfare in different regions of Somalia. This knowledge will help in developing culturally sensitive strategies that integrate traditional practices with modern welfare standards, ensuring a balance between cultural heritage and animal well-being.

Policy and governance frameworks: Further research are needed to assess the effectiveness and adequacy of existing policy and governance frameworks in promoting animal welfare in Somalia. This includes evaluating the implementation of animal welfare legislation, assessing institutional capacities for enforcement, and identifying gaps in policy coherence and coordination. Research findings can guide the development of robust policy frameworks

and institutional mechanisms to support the effective implementation of animal welfare standards. Collaborative research projects, involving local and international research institutions, can contribute to building a robust evidence base and generating context-specific knowledge to address the unique challenges faced in Somalia.

Addressing these research gaps and pursuing these future directions will provide valuable insights into the unique challenges and opportunities for animal welfare in Somalia. By conducting rigorous research, policymakers, practitioners, and stakeholders can make informed decisions, develop evidence-based interventions, and ensure that animal welfare is effectively integrated into sustainable development strategies in the country. Through collective efforts, knowledge sharing, and continuous learning, stakeholders can work towards the development and implementation of effective strategies and policies that promote the well-being of animals, support livelihoods, and contribute to the overall sustainable development of Somalia.

Conclusions and Recommendations

In conclusion, the integration of animal welfare into sustainable development strategies is vital for Somalia. By recognizing the interconnectedness between animal welfare, livelihoods, and environmental sustainability, Somalia can foster resilient livestock systems, preserve cultural practices, and promote social justice. Stakeholder engagement, partnerships, and capacity-building initiatives are essential for effective collaboration and resource optimization. Additionally, addressing research gaps, such as conducting socio-economic impact assessments, evaluating intervention effectiveness, considering cultural and contextual factors, and exploring the intersection of animal welfare and zoonotic disease prevention, will provide valuable insights to inform policy and decision-making processes. By leveraging research, promoting evidence-based interventions, and strengthening policy and governance frameworks, Somalia can enhance animal welfare, support sustainable livelihoods, and contribute to overall sustainable development in the country.

Acknowledgements

Novelty Statement

The novelty of this study lies in its comprehensive examination of the integration of animal welfare into sustainable development strategies in Somalia. By highlighting the intricate linkages between animal welfare, livelihoods, and environmental sustainability, this research presents a unique perspective on the potential benefits of prioritizing animal welfare in the context of a developing country. Furthermore, the identification of research gaps and future directions provides a roadmap for addressing critical knowledge deficiencies and advancing the understanding of animal welfare's impact on socio-economic factors, cultural practices, zoonotic disease prevention, and policy implementation. This study contributes to the emerging field of sustainable development by emphasizing the importance of animal welfare as an integral component of holistic and equitable development strategies.

Author's Contribution

AIM: Design the study; AIM, SAM and YAM: Prepare the draft, and AIM: Finalize the manuscript and provide critical comments and review. All authors read the manuscript and agree to be responsible for any aspect of the manuscript.

Conflict of interest
The authors have declared no conflict of interest.

References

Akhtar-Schuster, M., Thomas, R.J., Stringer, L.C., Chasek, P. and Seely, M., 2011. Improving the enabling environment to combat land degradation: Institutional, financial, legal and science-policy challenges and solutions. Land Degrad. Dev., 22(2): 299-312. https://doi.org/10.1002/ldr.1058

Akıncı, Ş., and Lösel, D.M., 2012. Plant water-stress response mechanisms. Water Stress, 25(15): 42. https://doi.org/10.5772/29578

Albernaz-Gonçalves, R., Olmos, A.G., and Hötzel, M.J., 2022. Linking animal welfare

and antibiotic use in pig farming. A review. Animals, 12(2): 216. https://doi.org/10.3390/ani12020216

Alinovi, L., Hemrich, G. and Russo, L., 2007. Addressing food insecurity in fragile states: case studies from the Democratic Republic of the Congo, Somalia and Sudan.

Björkbom, C., 2023. The EU sustainable food systems framework-potential for climate action. NPJ Climate Action, 2(1): 4. https://doi.org/10.1038/s44168-023-00034-9

Bowles, D., Paskin, R., Gutiérrez, M. and Kasterine, A., 2005. Animal welfare and developing countries: Opportunities for trade in high-welfare products from developing countries. Revue scientifique et technique-Office international des épizooties, 24(2): 783.

Bozzo, G., Marialaura, C., Giovanni, T., Gaia, C., Michela, M.D., Elena, C., Nazario, B., Roberta, B. and Francesco, E.C., 2021. Animal welfare, health and the fight against climate change: One solution for global objectives. Agriculture, 11(12): 1248. https://doi.org/10.3390/agriculture11121248

Branca, G., Lipper, L., McCarthy, N. and Jolejole, M.C., 2013. Food security, climate change, and sustainable land management. A review. Agron. Sustainable Dev., 33: 635-650. https://doi.org/10.1007/s13593-013-0133-1

Brown, M.J., Symonowicz, C., Medina, L.V., Bratcher, N.A., Buckmaster, C.A., Klein, H. and Anderson, L.C., 2017. Culture of care: Organizational responsibilities. Manage. Anim. Care Use Prog. Res. Educ. Test., pp. 11-26. https://doi.org/10.1201/9781315152189-2

Caporale, V., Alessandrini, B., Villa, P.D. and Del Papa, S., 2005. Global perspectives on animal welfare: Europe. Rev. Sci. Tech. Off. Int. Epizoot., 24(2): 567. https://doi.org/10.20506/rst.24.2.1594

Catley, A., Jeremy, L., and Ian, S., 2013. Pastoralism and development in Africa: Dynamic change at the margins. Taylor and Francis, pp. 328. https://doi.org/10.4324/9780203105979

Cattaneo, A., 2018. The state of food and agriculture 2018: Migration, agriculture and rural development. Food and Agriculture Organization of the United Nations (FAO), 2018.

Chiu, Y.R., Aghaloo, K. and Mohammadi, B., (2020). Incorporating rainwater harvesting systems in Iran's potable water-saving scheme by using a GIS-simulation based decision support system. Water, 12(3): 752. https://doi.org/10.3390/w12030752

Conde, D.A., Colchero, F., Gusset, M., Pearce-Kelly, P., Byers, O., Flesness, N., Browne, R.K. and Jones, O.R., 2013. Zoos through the lens of the IUCN Red List: A global metapopulation approach to support conservation breeding programs. PLoS One, 8(12): e80311. https://doi.org/10.1371/journal.pone.0080311

Cooney, R., Roe, D., Dublin, H. and Booker, F., 2018. Wild life, wild livelihoods: Involving communities in sustainable wildlife management and combatting the illegal wildlife trade. Combating illegal Wildlife Trade.

Cornet, S., and Barpanda, S., 2021. Exploring social innovation through co-creation in rural India using action research. Soc. Enterp. J., 17(2): 240-259. https://doi.org/10.1108/SEJ-12-2019-0099

Council, F.A.W., 2009. Farm animal welfare in Great Britain: Past, present and future.

Cox, J.H., 2023. Animal welfare-environment-sustainable development nexus: Scoping study.

Croney, C.C. and Millman, S.T., 2007. Board-invited review: The ethical and behavioral bases for farm animal welfare legislation. J. Anim. Sci., 85(2): 556-565. https://doi.org/10.2527/jas.2006-422

Dawkins, M.S., 2021. The science of animal welfare: Understanding what animals want. Oxford University Press, USA.

Dutch Government, 2022. Available at: https://www.government.nl/topics/international-organisations/netherlands-as-host-country (accessed 30 June 2023).

Escobar, L.S., Jara, W.H., Nizam, Q.N. and Plavšić, B., 2018. The perspective of the world organization for animal health. In: Advances in agricultural animal welfare. Woodhead Publ., pp. 169-182. https://doi.org/10.1016/B978-0-08-101215-4.00009-2

Faver, C.A., 2010. School-based humane education as a strategy to prevent violence: Review and recommendations. Children Youth Ser. Rev., 32(3): 365-370. https://doi.org/10.1016/j.childyouth.2009.10.006

Fernandes, J.N., Hemsworth, P.H., Coleman, G.J. and Tilbrook, A.J., 2021. Costs and benefits of improving farm animal

welfare. Agriculture, 11(2): 104. https://doi.org/10.3390/agriculture11020104

Fernandes, J., Blache, D., Maloney, S.K., Martin, G.B., Venus, B., Walker, F.R., Head, B. and Tilbrook, A., 2019. Addressing animal welfare through collaborative stakeholder networks. Agriculture, 9(6): 132. https://doi.org/10.3390/agriculture9060132

Fraser, D., 2008. Understanding animal welfare: The science in its cultural context. UFAW Animal Welfare Series. https://doi.org/10.1186/1751-0147-50-S1-S1

Fraser, D., and MacRae, A.M., 2011. Four types of activities that affect animals: Implications for animal welfare science and animal ethics philosophy. Anim. Welfare, 20(4): 581-590. https://doi.org/10.1017/S0962728600003213

Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. and Tempio, G., 2013. Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities. Food Agric. Organ. UN (FAO).

Ghislain, S., 2022. 12 Mainstreaming animal welfare. The sustainable development goals: Diffusion and contestation in Asia and Europe. pp. 6.

Glenny, W., Runyon, J.B. and Burkle, L.A., 2022. A review of management actions on insect pollinators on public lands in the United States. Biodiv. Conserv., 31(8-9): 1995-2016. https://doi.org/10.1007/s10531-022-02399-5

Grace, D., Mutua, F.K., Ochungo, P., Kruska, R.L., Jones, K., Brierley, L., Lapar, M.L., Said, M.Y., Herrero, M.T., Phuc, P.M. and Thao, N.B., 2012. Mapping of poverty and likely zoonoses hotspots.

Hall, D.C., Ehui, S. and Delgado, C., 2004. The livestock revolution, food safety, and small-scale farmers: Why they matter to us all. J. Agric. Environ. Ethics, 17(4-5): 425. https://doi.org/10.1007/s10806-004-5183-6

Hang, N.T., 2018. Supply chain collaboration (SCC)-A pilot study of small and medium enterprises (SMEs) in Danang. Asian Econ. Financial Rev., 8(3): 353-365. https://doi.org/10.18488/journal.aefr.2018.83.353.365

Hassan-Kadle, A.A., Osman, A.M., Shair, M.A., Abdi, O.M., Yusuf, A.A., Ibrahim, A.M. and Vieira, R.F., 2021. Rift Valley fever and *Brucella* spp. in ruminants, Somalia. BMC Vet. Res., 17(1): 1-6. https://doi.org/10.1186/s12917-021-02980-0

Henchion, M.M., Regan, Á., Beecher, M. and Macken, W.Á., 2022. Developing 'Smart' dairy farming responsive to farmers and consumer-citizens: A review. Animals, 12(3): 360. https://doi.org/10.3390/ani12030360

Herrero, M., Grace, D., Njuki, J., Johnson, N., Enahoro, D., Silvestri, S. and Rufino, M.C., 2013. The roles of livestock in developing countries. Animal, 7(s1): 3-18. https://doi.org/10.1017/S1751731112001954

Herrero, M., Henderson, B., Havlík, P., Thornton, P.K., Conant, R.T., Smith, P., Wirsenius, S., Hristov, A.N., Gerber, P., Gill, M. and Butterbach-Bahl, K., (2016). Greenhouse gas mitigation potentials in the livestock sector. Nat. Clim. Change, 6(5): 452-461. https://doi.org/10.1038/nclimate2925

Herrero, M., Wirsenius, S., Henderson, B., Rigolot, C., Thornton, P., Havlík, P., De Boer, I. and Gerber, P.J., 2015. Livestock and the environment: what have we learned in the past decade? Ann. Rev. Environ. Resour., 40: 177-202. https://doi.org/10.1146/annurev-environ-031113-093503

Horgan, R. and Gavinelli, A., 2006. The expanding role of animal welfare within EU legislation and beyond. Livest. Sci., 103(3): 303-307. https://doi.org/10.1016/j.livsci.2006.05.019

Imperial, M.T., 2005. Using collaboration as a governance strategy: Lessons from six watershed management programs. Admin. Soc., 37(3): 281-320. https://doi.org/10.1177/0095399705276111

Ingenbleek, P.T., Immink V.M., Spoolder H.A., Bokma M.H. and Keeling, L.J., 2012. EU animal welfare policy: Developing a comprehensive policy framework. Food Policy, 37(6): 690-699. https://doi.org/10.1016/j.foodpol.2012.07.001

Ingenbleek, P. and Krampe, C., 2022. The end of animal welfare labelling as we know it? Persisting problems at the consumer level and PLF-based solutions. Front. Anim. Sci., 3: 819893. https://doi.org/10.3389/fanim.2022.819893

Jesca, N., Barbara, N., Charles, S. and Joseph, W.M., 2016. An assessment of veterinary diagnostic services needs in Uganda. J. Vet. Med. Anim. Health, 8(7): 50-55. https://doi.org/10.5897/JVMAH2016.0462

Jirkof, P., Rudeck, J. and Lewejohann, L., 2019.

Assessing affective state in laboratory rodents to promote animal welfare what is the progress in applied refinement research? Animals, 9(12): 1026. https://doi.org/10.3390/ani9121026

Jull, J., Giles, A. and Graham, I.D., 2017. Community-based participatory research and integrated knowledge translation: Advancing the co-creation of knowledge. Implement. Sci., 12: 1-9. https://doi.org/10.1186/s13012-017-0696-3

Keeling, L.J., Marier, E.A., Olmos Antillón, G., Blokhuis, H.J., Staaf, L.B. and Stuardo, L., 2022. A global study to identify a potential basis for policy options when integrating animal welfare into the UN sustainable development goals. Front. Anim. Sci., 3: 974687. https://doi.org/10.3389/fanim.2022.974687

Keeling, L., Tunón, H., Olmos, A.G., Berg, C., Jones, M., Stuardo, L., Swanson, J., Wallenbeck, A., Winckler, C. and Blokhuis, H., 2019. Animal welfare and the United Nations sustainable development goals. Front. Vet. Sci., 6: 336. https://doi.org/10.3389/fvets.2019.00336

Kiper, T., 2013. Role of ecotourism in sustainable development. InTech. https://doi.org/10.5772/55749

Kotzé, E., Sandhage-Hofmann, A., Meinel, J.A., Du Preez, C.C. and Amelung, W., 2013. Rangeland management impacts on the properties of clayey soils along grazing gradients in the semi-arid grassland biome of South Africa. J. Arid Environ., 97: 220-229. https://doi.org/10.1016/j.jaridenv.2013.07.004

Kumar, S., and Singh, M.B., 2016. Role of livestock in sustainable agriculture development in Ballia District. Geographer, 63(2): 30-39.

Kwasny, T., Dobernig, K. and Riefler, P., 2022. Towards reduced meat consumption: A systematic literature review of intervention effectiveness, 2001–2019. Appetite, 2022: 168: 105739. https://doi.org/10.1016/j.appet.2021.105739

Larrondo, C., Bustamante, H. and Gallo, C., 2018. Sheep farmers' perception of welfare and pain associated with routine husbandry practices in Chile. Animals, 8(12): 225. https://doi.org/10.3390/ani8120225

Livestock Sector Analysis in Somalia, 2020. A comprehensive assessment of the livestock sector. Food and Agriculture Organization of the United Nations (FAO). 2020. Available at: http://www.fao.org/3/cb0886en/cb0886en.pdf (accessed 30 June 2023).

Ludwiczak, A., Skrzypczak, E., Składanowska-Baryza, J., Stanisz, M., Ślósarz, P. and Racewicz, P., 2021. How housing conditions determine the welfare of pigs. Animals, 11(12): 3484. https://doi.org/10.3390/ani11123484

Lundmark, H.F., Veggeland, F., Vågsholm, I. and Berg, C., 2021. Managing animal welfare in food governance in Norway and Sweden: Challenges in implementation and coordination. Animals, 11(7): 1899. https://doi.org/10.3390/ani11071899

Lusambili, A. and Nakstad, B., 2023. Awareness and interventions to reduce dehydration in pregnant, postpartum women, and newborns in rural Kenya. Afr. J. Primary Health Care Family Med., 15(1): 1-3. https://doi.org/10.4102/phcfm.v15i1.3991

MacKinnon, B., Debnath, P.P., Bondad-Reantaso, M.G., Fridman, S., Bin, H. and Nekouei, O., 2023. Improving tilapia biosecurity through a value chain approach. Rev. Aquacult., 15: 57-91. https://doi.org/10.1111/raq.12776

Magiri, R., Muzandu, K., Gitau, G., Choongo, K. and Iji, P., 2020. Impact of climate change on animal health, emerging and re-emerging diseases in Africa. Afr. Handb. Clim. Change Adapt., 2020: 1-18. https://doi.org/10.1007/978-3-030-42091-8_19-1

Mahmoud, H.A., 2010. Livestock trade in the Kenyan, Somali and Ethiopian borderlands. London: Chatham House/Royal Institute of International Affairs.

Manning, J., Power, D. and Cosby, A., 2021. Legal complexities of animal welfare in Australia: Do on-animal sensors offer a future option? Animals, 11(1): 91. https://doi.org/10.3390/ani11010091

Marai, I.F.M., El-Darawany, A.A., Fadiel, A. and Abdel-Hafez, M.A.M., 2007. Physiological traits as affected by heat stress in sheep. A review. Small Rumin. Res., 71(1-3): 1-12. https://doi.org/10.1016/j.smallrumres.2006.10.003

Matzembacher, D.E., Vieira, L.M. and de Barcellos, M.D., 2021. An analysis of multi-stakeholder initiatives to reduce food loss and waste in an emerging country–Brazil. Ind. Market. Manage., 93: 591-604. https://doi.org/10.1016/j.indmarman.2020.08.016

Maundu, P., Kibet, S., Morimoto, Y., Imbumi, M.

and Adeka, R., 2019. Impact of *Prosopis juliflora* on Kenya's semi-arid and arid ecosystems and local livelihoods. Biodiversity, 10(2-3): 33-50. https://doi.org/10.1080/14888386.2009.9712842

Mbow, H.O.P., Reisinger, A., Canadell, J. and O'Brien, P., 2017. Special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (SR2). Ginevra, IPCC, 2017: 650.

McBride, E.A. and Baugh, S., 2022. Animal welfare in context: Historical, scientific, ethical, moral and one welfare perspectives. In: Human/Animal Relationships in Transformation: Scientific, Moral and Legal Perspectives. Cham: Springer International Publishing, 2022: 119-147. https://doi.org/10.1007/978-3-030-85277-1_7

McDavid, L. and San, M.S.F., 2021. Using a community engagement program to promote veterinary medicine while helping veterinary students improve their communication skills and increase their cultural understanding and well-being. J. Am. Vet. Med. Assoc., 258(12): 1322-1324. https://doi.org/10.2460/javma.258.12.1322

McDowall, S., Hazel, S.J., Chittleborough, C., Hamilton-Bruce, A., Stuckey, R. and Howell, T.J., 2023. The Impact of the social determinants of human health on companion animal welfare. Animals, 13(6): 1113. https://doi.org/10.3390/ani13061113

McGreevy, P., 2012. Equine behavior: A guide for veterinarians and equine scientists. Elsevier Health Sciences.

Mekonnen, M.M. and Hoekstra, A.Y., 2012. A global assessment of the water footprint of farm animal products. Ecosystems, 15(3): 401-415. https://doi.org/10.1007/s10021-011-9517-8

Mellor, D.J., 2016. Updating animal welfare thinking: Moving beyond the "Five Freedoms" towards "a Life Worth Living". Animals, 6(3): 21. https://doi.org/10.3390/ani6030021

Mellor, D., Patterson-Kane, E. and Stafford, K.J., 2009. The sciences of animal welfare. John Wiley and Sons.

Mohamed, S.A., Mohamud, A.I., Mohamed, Y.A., Mishra, P. and Jama, O.S.A., 2021. Assessment of knowledge, attitude, and practices of population towards brucellosis in Benadir Region, Somalia. Vet. Sci. Res. Rev., 7(1): 25-30. https://doi.org/10.17582/journal.vsrr/2021/7.1.25.30

Mohamud, A.I., Mohamed, Y.A. and Mohamed, M.I., 2020. Sero-prevalence and associated risk factors of bovine brucellosis in selected districts of Benadir Region, Somalia. J. Istanbul Vet. Sci., 4(2): 57-63. https://doi.org/10.30704/http-www-jivs-net.757196

Morales, R.E., Díaz, O.E.A., Medina, T.C.A., García, L., Oliva, M. and Rojas, B.N.B., 2021. A rainwater harvesting and treatment system for domestic use and human consumption in native communities in Amazonas (NW Peru): Technical and economic validation. Scientifica, pp. 1-17. https://doi.org/10.1155/2021/4136379

Moyo, S., Swanepoel, F. and Stroebel, A., 2010. The role of livestock in developing communities: Enhancing multifunctionality. UJ Press, 2010: 236. https://doi.org/10.18820/9781928424819

Muneza, A., Doherty, J.B., Hussein, A.A., Fennessy, J., Marais, A., O'Connor, D. and Wube, T., 2018. Giraffa camelopardalis ssp. reticulata. The IUCN Red List of Threatend Species, 2018.

Napolitano, F., Girolami, A. and Braghieri, A., 2010. Consumer liking and willingness to pay for high welfare animal-based products. Trends Food Sci. Technol., 21(11): 537-543. https://doi.org/10.1016/j.tifs.2010.07.012

Nielsen, S.S., Denwood, M.J., Forkman, B. and Houe, H., 2017. Selection of meat inspection data for an animal welfare index in cattle and pigs in Denmark. Animals, 7(12): 94. https://doi.org/10.3390/ani7120094

Nori, M., Kenyanjui, M.B., Yusuf, M.A. and Mohammed, F.H., 2016. Milking drylands: The marketing of camel milk in north-east Somalia. Nomadic Peoples, 10(1): 9-28. https://doi.org/10.3167/082279406781020392

OIE, 2021a. strategy on animal welfare and veterinary services for better animal health and welfare. World Organization for Animal Health (OIE). 2021a: Available at: https://www.oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/EN_OIE_Strategy_2017.pdf (accessed 30 June 2023).

OIE, 2021b. One Welfare: a framework to support the implementation of OIE animal welfare standards. World Animal Health Organizations, 2021b: Available at: https://www.woah.org/

app/uploads/2021/03/bull-2017-1-eng.pdf (accessed 30 June 2023).

Olmos, A.G., Tunón, H., De Oliveira, D., Jones, M., Wallenbeck, A., Swanson, J. and Keeling, L., 2021. Animal welfare and the United Nations' sustainable development goals broadening students perspectives. Sustainability, 13(6): 3328. https://doi.org/10.3390/su13063328

One Welfare, 2021b. A framework to support the implementation of OIE animal welfare standards. World Animal Health Organizations, 2021b: Available at: https://www.woah.org/app/uploads/2021/03/bull-2017-1-eng.pdf (accessed 30 June 2023).

Parlasca, M., Knößlsdorfer, I., Alemayehu, G. and Doyle, R., 2023. How and why animal welfare concerns evolve in developing countries. Anim. Front., 13(1): 26-33. https://doi.org/10.1093/af/vfac082

Perino, G. and Schwickert, H., 2023. Animal welfare is a stronger determinant of public support for meat taxation than climate change mitigation in Germany. Nat. Food, 4(2):160-169. https://doi.org/10.1038/s43016-023-00696-y

Polsky, L. and von Keyserlingk, M.A., 2017. Invited review: Effects of heat stress on dairy cattle welfare. J. Dairy Sci., 100(11): 8645-8657. https://doi.org/10.3168/jds.2017-12651

Qekwana, D.N., Mccrindle, C.M.E., Cenci-Goga, B.T. and Grace, D., 2019. Animal welfare in Africa: Strength of cultural traditions, challenges and perspectives.

Rawles, K., 2012. Sustainable development and animal welfare: The neglected dimension. In: Animals, Ethics and Trade. Routledge, 2012: 208-216.

Rodriguez, F.M.B., 2022. Animal welfare underenforcement as a rule of law problem. Animals, 12(11): 1411. https://doi.org/10.3390/ani12111411

Rojas-Downing, M.M., Nejadhashemi, A.P., Harrigan, T. and Woznicki, S.A., 2017. Climate change and livestock: Impacts, adaptation, and mitigation. Clim. Risk Manage., 16: 145-163. https://doi.org/10.1016/j.crm.2017.02.001

Rushen, J., Butterworth, A. and Swanson, J.C., 2011. Animal behavior and well-being symposium: Farm animal welfare assurance: Science and application. J. Anim. Sci., 89(4): 1219-1228. https://doi.org/10.2527/jas.2010-3589

Sansoucy, R., 1995. Livestock-a driving force for food security and sustainable development. World, 3074(5389), 1035.

Sansoucy, R., 2023. A driving force for food security and sustainable development. World, 3074(5389): 1035.

Sartore-Baldwin, M., 2022. Measuring sustainable development goal 15. In: The routledge handbook of sport and sustainable development. Routledge, pp. 382-392. https://doi.org/10.4324/9781003023968-45

Schmidt, K., 2011. Concepts of animal welfare in relation to positions in animal ethics. Acta Biotheoretica, 59: 153-171. https://doi.org/10.1007/s10441-011-9128-y

Shukla, P.R., Skea, J., Calvo Buendia, E., Masson-Delmotte, V., Pörtner, H.O., Roberts, D.C., Zhai, P., Slade, R., Connors, S., Van Diemen, R. and Ferrat, M.I.P.C.C., 2019. Climate change and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.

Sinclair, M., Fryer, C. and Phillips, C.J., 2019. The benefits of improving animal welfare from the perspective of livestock stakeholders across Asia Anim., 9(4): 123. https://doi.org/10.3390/ani9040123

Sinclair, M., Zito, S., Idrus, Z., Yan, W., van Nhiem, D., Lampang, P.N. and Phillips, C.J.C., 2017. Attitudes of stakeholders to animal welfare during slaughter and transport in SE and E Asia. Anim. Welfare, 26(4): 417-425. https://doi.org/10.7120/09627286.26.4.417

Sjödin, D., 2019. Knowledge processing and ecosystem co-creation for process innovation: Managing joint knowledge processing in process innovation projects. Int. Entrepreneur. Manage. J., 15(1): 135-162. https://doi.org/10.1007/s11365-018-0550-3

Smith, K.K., 2012. Governing animals: Animal welfare and the liberal state. OUP USA. https://doi.org/10.1093/acprof:oso/9780199895755.001.0001

Steinfeld, H., Gerber, P., Wassenaar, T.D., Castel, V., Rosales, M., Rosales, M. and de Haan, C., 2006. Livestock's long shadow: Environmental issues and options. Food Agric. Org.

Strauch, A.M., Kapust, A.R. and Jost, C.C., 2009. Impact of livestock management on water quality and streambank structure in a semi-arid, African ecosystem. J. Arid Environ.,

73(9): 795-803. https://doi.org/10.1016/j.jaridenv.2009.03.012

Sutherland, M.A., 2015. Welfare implications of invasive piglet husbandry procedures, methods of alleviation and alternatives. A review. N. Z. Vet. J., 63(1): 52-57. https://doi.org/10.1080/00480169.2014.961990

Sutherland, M.A. and Tucker, C.B., 2011. The long and short of it: A review of tail docking in farm animals. Appl. Anim. Behav. Sci., 135(3): 179-191. https://doi.org/10.1016/j.applanim.2011.10.015

Szűcs, E., Geers, R., Jezierski, T., Sossidou, E.N. and Broom, D.M., 2012. Animal welfare in different human cultures, traditions and religious faiths. Asian-Australas. J. Anim. Sci., 25(11): 1499. https://doi.org/10.5713/ajas.2012.r.02

Temple, D. and Manteca, X., 2020. Animal welfare in extensive production systems is still an area of concern. Front. Sustainable Food Syst., 4: 545902. https://doi.org/10.3389/fsufs.2020.545902

Teresa, C.M., Colombino, E., Tarantola, M., Biagini, D., Giovanni, A.L., Marco, M.A. and Guarda, F., 2019. The disturbed habitat and its effects on the animal population. In: The Disturbed Habitat and Its Effects on the Animal Population Intech Open, 2019: 1-12.

The OIE standards, World Animal Health Organizations (OIE), 2016. Available at: https://www.woah.org/app/uploads/2021/03/en-normes.pdf (accessed 30 June 2023).

Thiermann, A.B. and Babcock, S., 2005. Animal welfare and international trade. Revue scientifique et technique (International Office of Epizootics), 24(2): 747-755. https://doi.org/10.20506/rst.24.2.1600

Thornton, P.K., Herrero, M.T., Freeman, H., Okeyo, M.A., Rege, J., Jones, P.G. and McDermott, J.J., 2007. Vulnerability, climate change and livestock-opportunities and challenges for the poor. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Hyderabad, India.

Thornton, P.K., van de Steeg, J., Notenbaert, A. and Herrero, M., 2009. The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. Agric. Syst., 101(3): 113–127. https://doi.org/10.1016/j.agsy.2009.05.002

UN's Sustainable Development Goals (SDGs), 2023. Available at: https://wellbeingintl.org/animal-welfare-and-the-uns-sustainable-development-goals-sdgs/ (accessed 30 June 2023).

Union, A., 2013. Policy framework for pastoralism in Africa: Securing, protecting and improving the lives, livelihoods and rights of pastoralist communities.

Vapnek, J. and Chapman, M.S., 2010. Legislative and regulatory options for animal welfare. FAO legislative study, pp. 104.

Vijayalakshmy, K., Chakraborty, S., Biswal, J. and Rahman, H., 2023. The role of rural Indian women in livestock production. Eur. J. Hum. Soc. Sci., 3(1): 91-98. https://doi.org/10.24018/ejsocial.2023.3.1.395

Walker-Munro, B., 2015. Cattle v the crown: Is there a place for the Commonwealth as animal welfare guardian? Univ. Queensland Law J., 34(2): 363-391.

Wamukoya, F.D., 2013. Devolution of wildlife management in Kenya to enhance community participation: an assessment of Kenyan legal frameworks (Doctoral dissertation), the University of Nairobi, Nairobi, Kenya Available at: http://erepository.uonbi.ac.ke/bitstream/handle/11295/60144/Wamukoya_Devolution%20of%20wildlife%20management%20in%20Kenya%20to%20enhance%20community%20participation.pdf?sequence=3 (accessed 30 June 2023).

Young, A., Khalil, K.A. and Wharton, J., 2018. Empathy for animals: A review of the existing literature. Curator Mus. J., 61(2): 327-343. https://doi.org/10.1111/cura.12257

Zucker, I.H., Brown, M.J., Symonowicz, C., Medina, L.V., Bratcher, N.A., Buckmaster, C.A. and Sharpless, M., 2018. Management of animal care and use programs in research, education, and testing.