v.6, n.1, 2024, DOI: 10.52664/rima.v6.n1.2024.e244

RIMA
Revista Interdisciplinar e do Meio Ambiente
Interdisciplinary and Environment Journal

Street animals and One Health: Opportunities as a response to Cosean solutions

Animales de la calle y Una sola salud: Oportunidades como respuesta a las soluciones del Cosean

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Abstract: The Coase Theorem emphasizes negotiation and voluntary interactions between the involved parties (government and society) in the face of externalities. It suggests that, under certain conditions, parties can reach an agreement leading to an efficient allocation of resources, regardless of who holds the property rights or, in this case, the responsibility. Thus, the main objective of this study is to investigate and present Coasean solutions as an effective response to addressing the issue of stray animals, promoting the health and well-being of these animals in an integrated manner with public health and the environment. To achieve this goal, this research adopted a qualitative, documentary, and bibliographic methodology, combined with the analysis of DataSus data along with a literature review on One Health, Coasean solutions, and approaches to the stray animal problems. The results demonstrated that the opportunities for Coasean responses are vast and promising. However, collaboration among the government, the population, businesses, and NGOs is the key to a sustainable resolution of the negative externalities generated by stray animals. By understanding One Health as an integrated approach, we can not only improve the quality of life for these animals but also promote public health, mitigate environmental impacts, and build a more aware and compassionate society.
Keywords: *One Health; Coase Theorem; Stray Animals.*

Resumen: El Teorema de Coase hace hincapié en la negociación y las interacciones voluntarias entre las partes implicadas (gobierno y sociedad) frente a las externalidades. Sugiere que, en determinadas condiciones, las partes pueden llegar a un acuerdo que conduzca a una asignación eficiente de los recursos, independientemente de quién ostente los derechos de propiedad o, en este caso, la responsabilidad. Así, el objetivo principal de este estudio es investigar y presentar soluciones coaseanas como respuesta eficaz para abordar la cuestión de los animales vagabundos, promoviendo la salud y el bienestar de estos animales de forma integrada con la salud pública y el medio ambiente. Para alcanzar este objetivo, esta investigación adoptó una metodología cualitativa, documental y bibliográfica, combinada con el análisis de datos de DataSus junto con una revisión bibliográfica sobre One Health, soluciones Coasean y enfoques del problema de los animales vagabundos. Los resultados demostraron que las oportunidades de respuestas coaseanas son amplias y prometedoras. Sin embargo, la colaboración entre el gobierno, la población, las empresas y las ONGs es clave para una resolución sostenible de las externalidades negativas generadas por los animales vagabundos. Entendiendo Una Salud como un enfoque integrado, no sólo podemos mejorar la calidad de vida de estos animales, sino también promover la salud pública, mitigar el impacto ambiental y construir una sociedad más consciente y compasiva."
Palabras clave: *Una sola salud; Teorema de Coase; Animales del rúa.*

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Received for publication on 2024/04/04; approved on 2023/10/25.
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INTRODUCTION

Public Health has a very unique meaning, but it is of great importance to the Brazilian people (ou Brazilians) and the world's population. It is defined not only by the absence of disease, but also by physical, mental and social well-being as a whole (WHO, 2000). Good planning for access to health can define the quality of the spaces we use, access to the food we eat and adequate and effective health care for all. Just like human health, animal health is complex, faces challenges and it is constantly evolving to innovate effective solutions to combat diseases that are threatened by animals, welfare and behavioral care is also essential (Brazil, 2019).

One Health, known worldwide as *One Health,* represents an essential interconnection among human health, animal health and environmental health. This link is recognized as a global strategy to contain the spread of zoonotic diseases and restore balance to the planet. Its approach is multisectoral and transdisciplinary, aimed at enhancing synergy in tackling emerging and re-emerging zoonotic diseases (Hogerwerf *et al*., 2020; Belot *et al*., 2021; Souza; Caveião; Sales, 2022).

The concept of "*One Health*" was introduced around 100 years ago and clearly portrays a One-Health approach, considering animal health, human health and plant health interconnected in the environment (Brasil, 2019). According to the *World Organization for Animal Health* (WOAH) (2019), 60% of diseases affecting humans are zoonotic in origin and 75% of emerging human infectious diseases are caused by animals. In order to effectively guarantee human health, it is crucial to combat these pathogens at the animal source (Araújo; Silva and Leal, 2020).

This interconnection among humans, animals and the environment forms a complex and interdependent system. What happens in one place has widespread impacts, highlighting the importance of living in harmony with the environment and animals. This understanding and collaboration between different disciplines and sectors is fundamental to the concept of One Health. When examining past epidemics, it is clear that the occurrence of a pandemic is the result of the convergence of several factors (Schneider and Oliveira, 2020).

Based on this information, the situation of street animals in Brazil is alarming. According to data from the World Health Organization (WHO) in 2022, the country will be home to around 30 million abandoned animals, 20 million of which will be dogs and 10 million cats. In the most densely populated urban areas, the ratio between inhabitants and street animals is even more worrying, reaching one abandoned dog for every five inhabitants, with 10% of these animals living in situations of abandonment (WHO, 2022). This reality, as well as representing a public health challenge, highlights the need for a comprehensive and humane approach to dealing with this growing issue. The effects of the presence of street animals are felt in many ways by the population, including the spread of disease, the increase in

accidents, such as being run over, and the suffering conditions in which these animals often find themselves. It is therefore urgent to recognize that these living beings deserve care, protection and love, just like human beings.

In addition to zoonoses, there are several situations in which the principles of One Health can be applied, such as food safety, microbial resistance to antibiotics, climate change and wildlife conservation (Kelly *et al*., 2013). Its approach goes beyond the prevention of zoonoses and includes benefits for human health derived from living with animals. This manifests to itself in advantages such as the use of animals in food production, in tests for research into human pathogens and in pet-assisted therapy. In other words, not just the prevention of zoonoses, but also the promotion of *zooeyia*, a term of Greek origin that refers to the positive impacts of the relationship between animals and humans (Hodgson and Darling, 2011).

In this context, this article explores solutions based on the principles of the Coase Theorem approach, which promotes a holistic view of animal, human and environmental health. These solutions have the potential to provide an effective response to the problem of homeless animals, addressing not only the health aspects, but also the general well-being of these animals and harmony with society.

Therefore, the aim of this article is to investigate and present Cosean solutions as an effective response to address the problem of homeless animals, promoting the health and well-being of these animals in an integrated way with public health and the environment.

The Coase Theorem emphasizes negotiation and voluntary interactions between the parties involved (government and society) in the externality. It suggests that, under certain conditions, the parties can reach an agreement that leads to an efficient allocation of resources, regardless of who holds the property rights, in this case responsibility. The Cosean approach, which considers the interconnection among animal, human and environmental health, is fundamental to promoting sustainability. This is because the health of animals and the environment is intrinsically linked to human health and, by protecting animals and the environment, we are contributing to a healthier planet for everyone.

THEORETICAL BACKGROUND

The theoretical framework explored in this work includes two fundamental perspectives: the integrated approach known as *One Health,* aimed at human, animal and environmental health, and the Coase Theorem, which offers an analysis of efficiency in the resolution of externalities.

One Health: An integrated approach to human, animal and environmental health

The understanding of the interrelationship between animal and human health dates back to the time of Hippocrates, but it wasn't until the 18th century when the German scientist Rudolf Virchow

elucidated this connection more clearly. During the 1940s, in the United States, the Division of Veterinary Public Health was established in what was then known as the Center for Communicable Diseases, now called the Centers for Disease Control and Prevention (CDC).

During this same period, the Pan American Health Organization (PAHO) initiated the Veterinary Public Health Program, recognizing the importance of collaboration between veterinary medicine and public health to control zoonotic diseases such as rabies, brucellosis and leptospirosis (Schneider, Munoz-Zanzi; Min, 2019; Schneider; Oliveira, 2020).

In Brazil, rabies was identified as the first priority zoonosis. In 1973, an agreement between the ministries of Health and Agriculture led to the creation of the National Rabies Prophylaxis Program. From the outset, this program was based on an integrated surveillance and case notification system, covering humans as well as domestic and wild animals (Schneider; Oliveira, 2020).

The conceptualization of *One Health* as a "collaborative effort across disciplines at local, national and global levels to achieve optimal health for people, animals and the environment" suggests that multidisciplinary approaches in research, education, various services and policies can be the key to informing evidence-based decisions in the area of health and to developing diverse solutions to the challenges at the intersection of animals, humans and ecosystems (Carneiro; Pettan-Brewer, 2021).

In 2008, a number of international organizations (FAO, WHO, UNEP, OIE) sought to translate the *One Health* approach into effective policies in all countries. The leaders of the partnership first encourage the prioritization of the *One Health* approach on the international political agenda, aiming for greater understanding and more effective interdisciplinary governance in the area of health.

This integrated approach, expressed in the "One World, One Health" initiative, recognizes the essential interconnection between human health, animal health and environmental health. It also guides policies, legislation, research and the implementation of programs in which multiple sectors collaborate, communicate and work together to reduce risks and preserve health (Ellwanger; Chies, 2022).

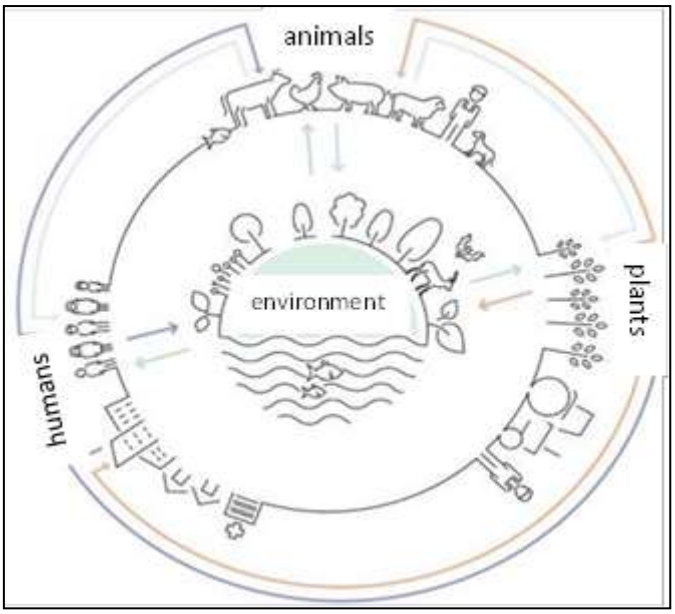
According to the *World Health Organization* (WHO) (2023) the "One Health" approach is an integrated concept that seeks to sustainably harmonize and optimize the health of people, animals and ecosystems. This perspective recognizes the close interconnection and interdependence of human health, domestic and wild animals, plants and the environment as a whole, including ecosystems. The approach mobilizes diverse sectors, disciplines and communities at various levels of society to collaborate in promoting well-being by tackling threats to health and ecosystems. This is done while addressing the collective need for clean water, energy and air, safe and nutritious food, action on climate change and contributions to sustainable development.

The fundamental principles underlying this approach include:

> 1. equity between sectors and disciplines;
> 2. Socio-political and multicultural parity (the doctrine that all people are equal and deserve equal rights and opportunities) and inclusion and involvement of marginalized communities and voices;
> 3. Socio-ecological balance that seeks a harmonious balance in human-animal-environment interaction, recognizing the importance of biodiversity and access to sufficient space and natural resources, as well as the intrinsic value of all living beings within the ecosystem;
> 4. Human stewardship and responsibility in changing behaviors and adopting sustainable solutions that recognize the importance of animal welfare and the integrity of the entire ecosystem, thus ensuring the well-being of current and future generations; and
> 5. Transdisciplinary and multisectoral collaboration, which includes all relevant disciplines, modern and traditional forms of knowledge and a representative and broad range of perspectives (WHO, 2023, p. 8).

Figure 01 is a schematic representation of the One Health concept, illustrating the interconnection between humans and animals.

FIGURE 01: One Health.



SOURCE: Adapted from World Organization for Animal Health (WOAH) (2023).

In line with the One Health High-Level Expert Panel definition (OHHLEP), the One Health approach aims to prevent, anticipate, detect and respond to health threats, addressing the following aspects: (I) "understand", since the processes of investigating and understanding outbreaks, epidemics and pandemics precede or occur simultaneously with initiatives to respond to these public health problems; (II) "prevent", since prevention and anticipation strategies are often interlinked; and (III) "control",

integrating detection and response actions to infectious and parasitic diseases, since such measures are also generally associated in practice (Ellwanger; Chies, 2022).

Animal health is impacted by the sanitary problems present in urban environments. For example, various infectious and parasitic diseases, such as leishmaniasis, toxoplasmosis and echinococcosis, can affect dog populations. The movement of these animals among cities, homes and vegetated areas contributes to the spread of pathogens among these different environments, increasing the risk of zoonotic diseases in the human population. In addition, this movement of dogs poses a threat to the health of wild animals that live near urban environments (Ellwanger; Chies, 2022).

FAO plays a crucial role in promoting the *One Health* approach in various areas, such as food security, sustainable agriculture, antimicrobial resistance, nutrition, animal health, plant health, fisheries and livelihoods. The effective application of the *One Health* approach is the key to anticipating, preventing, detecting and controlling diseases that affect both animals and humans. In addition, it contributes to combating microorganism resistance, ensuring food safety and preventing threats to human and animal health related to the environment (FAO, 2023).

The US Department of Agriculture (USDA) also incorporates the *One Health* approach into its innovation agenda. Recognizing the interconnection between the health of people, animals and the environment, the USDA, through the *Animal and Plant Health Inspection Service* (APHIS), adopts the *One Health approach* in efforts to eradicate and control diseases in livestock and wildlife species. This approach considers the interaction between humans, animals and the natural environment, and is exemplified in the work to eradicate tuberculosis in livestock and reduce rabies in wildlife. Experts, such as veterinarians, wildlife professionals and epidemiologists, collaborate to understand, identify and control diseases, including Covid-19, in a variety of animals (U.S. Department Of Agriculture, 2023).

The concept of One Health also plays a crucial role in science in the face of ongoing biodiversity losses. The *One Health* approach is particularly relevant for dealing with emerging infectious diseases, as around three out of four of these diseases in humans originate in animals. However, most public health policies in the world do not fully embrace the fundamentals of preventing diseases and safeguarding besides promoting health. This requires the joining of efforts from different sectors through interdisciplinary collaboration, recognizing the interdependence between the essential elements of the human/animal/environment triad. There is often a lack of attention to the institutional, political and social factors related to the implementation of these public policies from a single health perspective (CARNEIRO; PETTAN-BREWER, 2021).

Today, the *One Health* approach is taking on increasing importance when dealing with the ramifications of the climate crisis and its repercussions on health. These risks are on an upward trajectory,

as climate change is already demonstrating a series of impacts, both direct and indirect, on human health. In addition, the decline of biodiversity is emerging as a significant threat, particularly in the context of food security.

Coase Theorem: An analysis of efficiency in resolving externalities

In the 1950s, *Resources for the Future* (RFF) pioneered the first studies to explore the interaction between the economy and the environment. RFF, a non-profit organization based in Washington, USA, focuses on research related to environmental, energy and natural resource issues. However, it was from the 1960s onwards that economic science began to address environmental issues more comprehensively, especially after the release of the book "Silent Spring" by biologist Rachel Carson in 1962. The book highlighted the damage caused by pesticides on a large scale, attracting public attention (Fontgalland, 2022).

In the same period, the article "*The Problem of Social Cost*", by the renowned British economist Ronald Coase, was published in the prestigious academic journal *The Journal of Law and Economics,* from the University of Chicago. In this work, Coase explores the impact of externalities in the market context, also examining the crucial role of law in this scenario. Recognized as one of the fundamental pieces that led the author to win the Nobel Prize in Economics in 1991, this work represents a contribution of great relevance (Kauffman, 2018).

Coase (1960) pointed out that resolving externalities does not necessarily require the exclusive intervention of the public apparatus, as proposed by Pigou's theory, which advocates a robust state solution to these issues. Coase observed that direct negotiation between individuals could effectively address a large part of the problems, provided that some specific conditions were met: The presence of free bargaining, clear property rights and low or non-existent transaction costs.

According to Gomes and Fontgalland (2023), the Coase Theorem is a central result in environmental economics. In addition to showing, under certain conditions, how economic agents can arrive at an efficient solution to remedy externalities, without the direct involvement of the government, it links two sciences: Law and economics. Before Coase's seminal work, economists thought that externalities, which are at the heart of environmental economics, required government regulation.

Coase bases his analysis on the premise that issues related to social costs are common events in the routine of individuals and often arise from externalities, especially negative ones. In contrast, the legal system judges both exceptional and everyday events in a uniform manner, treating the law as effective as long as it does not discriminate. In this context, the price system operates unimpeded (which means that

costs are passed on to the party that bears the brunt of the damage - a system in which loss equals cost; benefit equals profit), presumably resulting in fairer compensation for the injured party after the fact.

Coase argues that the assumption of social responsibility on the part of the private actor could lead to an efficient level, since an "agreement" would be mutually beneficial for both the party who caused the damage and the one who suffered it (since adjustments would be discussed outside the market system). In short, through the payment of compensation, the actual negotiation process (division of the surplus) demonstrates efficiency and favors the injured party more (Gomes; Fontgalland, 2023).

An externality arises whenever the well-being of an individual, whether a company or a family, depends not only on their own actions, but also on the actions under the control of another individual. Historically, the terms external cost (external diseconomy) and external benefit (external economy) have been used to describe situations in which the affected parties are harmed or benefited by external actions. However, external benefits are less evident in the market system, as market agents often do not provide them (Tietenberg; Lewis, 2018; Fontgalland, 2022).

Transposing this concept to the context of street animals and unique health, it is possible to identify opportunities for innovative and collaborative approaches. The presence of street animals generates negative externalities, such as risks of zoonotic diseases and impacts on public health. However, the application of the Coase Theorem suggests that the parties involved, including communities, health agencies and animal protectors, can collaborate to find effective solutions. By negotiating and establishing clear property rights over the management and care of street animals, minimizing transaction costs, more efficient outcomes can be achieved. This integrated approach can not only improve animal welfare, but also contribute to the promotion of unique health, recognizing the interconnection between human, animal and environmental health.

METHODOLOGY

This research adopted a qualitative, documentary and bibliographic methodology, combining *DataSus* data analysis with a literature review on *One Health*, Cosean solutions and approaches to the problem of street animals. Data available on the SUS Hospital Information System (DataSus) was used to identify the main diseases and human health problems related to dogs and cats. This is information on hospital admissions and the regions most affected in Brazil, identifying the most frequent diseases and the places where they occur most frequently. This makes it possible to understand the extent of the public health and environmental impacts caused by the problem of homeless animals.

In addition, a review was carried out of the scientific literature relating to Cosean solutions (covering animal, human and environmental health) in relation to street animals. This includes studies and

articles that propose integrated approaches to tackling the problem, such as population control programs, veterinary care, public education and awareness-raising. The VHL Health database, which concentrates scientific information in the health area, and Google Scholar were used, using key terms related to street animals, animal health, human health, *One Health* and Cosean Solutions. The academic articles identified were reviewed and assessed for their relevance to the research.

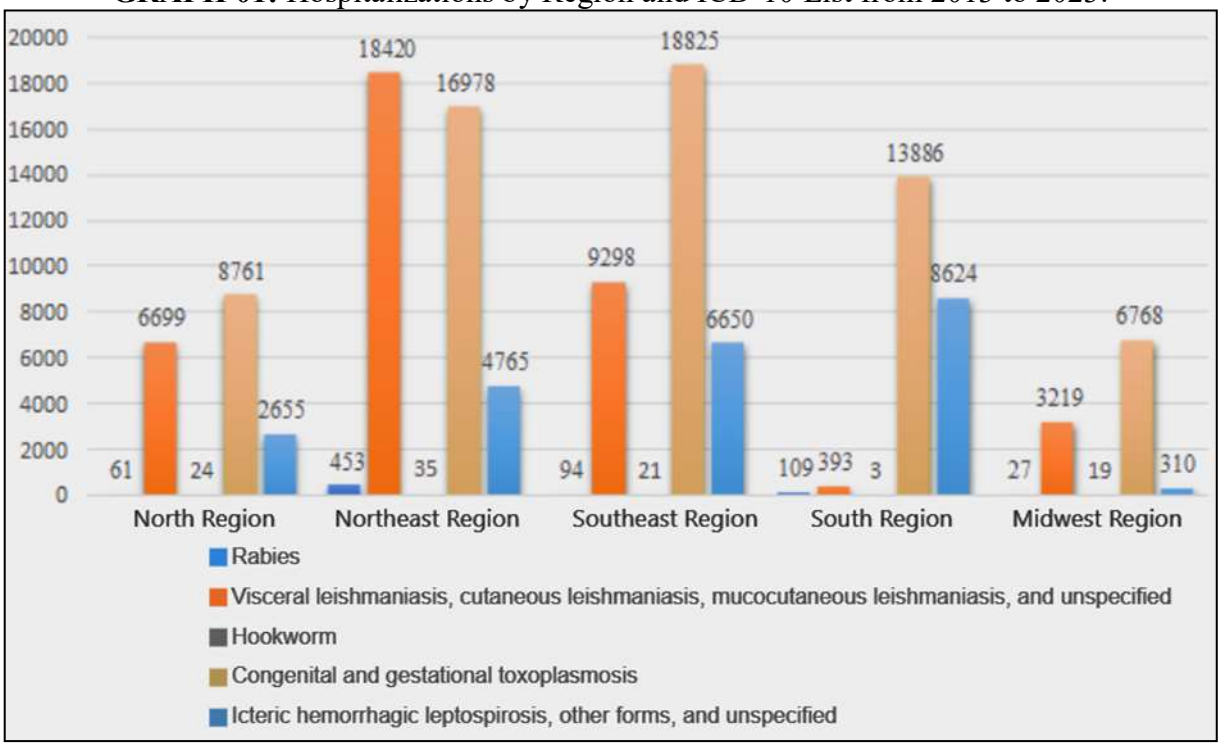
The results of the DataSus data analysis, the literature review and the articles found on BVs Saúde were integrated to identify possible Cosean solutions that could be applied to mitigate the problems associated with homeless animals, considering both interventions aimed at the animals and those involving community awareness and public policies.

RESULTS AND DISCUSSIONS

Main health problems related to street animals

Street animals, such as dogs and cats, face a number of health-related challenges due to lack of regular care, exposure to adverse conditions and lack of proper nutrition. Graph 01 shows some disease data for the last 10 years (2013 to 2023):

GRAPH 01: Hospitalizations by Region and ICD-10 List from 2013 to 2023.



SOURCE: Ministry of Health - SUS Hospital Information System (SIH/SUS), (2023).

Analysis of the epidemiological data reveals significant disparities in the incidence of various animal-borne diseases in the different regions of Brazil, as classified by ICD-10. It is noticed that rabies has the greatest impact in the Northeast, followed by the Southeast, while the incidences in the South, North and Midwest are relatively lower. Leishmaniasis is also more prevalent in the Northeast, with considerable numbers in the Southeast and Midwest, in contrast to lower incidences in the North and South. Hookworm disease, predominantly present in the Northeast, stands out for its low occurrence in the other regions. In the case of toxoplasmosis, the Southeast leads the way in terms of incidence, followed by the Northeast, while the other regions have lower rates, especially the South. As for leptospirosis, the Southeast again stands out and is accompanied by considerable numbers in the South, while the other regions show varying incidences.

These analyses highlight the complexity of epidemiological dynamics, pointing to the need for prevention and control strategies adapted to the particularities of each region, taking into consideration, socio-economic, climatic and geographical factors. It is important to consider that the figures can be influenced by factors such as the quality of epidemiological surveillance, access to health services and variations in diagnostic practices.

According to Ellwanger and Chies (2022), in the Brazilian context, epidemiological surveillance plays a crucial role in understanding the spread of diseases by incorporating both traditional methods, such as epidemiological and serological techniques, and advanced genomic tools. This collaborative effort involved a variety of specialists, including field epidemiologists, virologists, biologists, and other professionals, who joined forces to map the epidemiological scenario and identify the factors associated with the spread of diseases in the national territory. It is worth noting that, in addition to its application in epidemic or pandemic scenarios, the One Health approach can also offer valuable contributions to understanding endemic diseases. Expenses related to diseases caused by homeless animals, such as cats and dogs, represent a considerable portion of healthcare costs. These expenses encompass a variety of aspects, from medical treatment for individuals who have contracted zoonotic diseases to population control programs for these animals to prevent the spread of diseases.

Diseases such as rabies, transmitted mainly through bites from infected animals, require immediate treatment and post-exposure prophylaxis, involving considerable financial resources. In addition, zoonoses such as toxoplasmosis, leishmaniasis and leptospirosis, which can be associated with the presence of stray animals, require investment in diagnosis, treatment and prevention.

The costs also include the implementation of public policies, awareness campaigns, vaccination programs and actions aimed at population control of these animals, in order to mitigate the risk of disease transmission to the human population. In this context, the One Health approach gains relevance, as it

integrates efforts in the human, animal and environmental spheres to promote effective and sustainable strategies in public health management.

Human history has shown the emergence, circulation and sometimes stabilization of pathogens in human or animal populations. These infectious agents transit during a specific period, and can become endemic in certain regions or disappear over time. The dynamics of the relationship between humans and pathogens are fluid, subject to constant change. In a globalized world, characterized by high connectivity between populations from different continents, events such as wars, migrations, environmental degradation and social disparities become evident that the perspective of One Health (Ellwanger; Chies, 2022).

Main environmental problems related to street animals

Dogs and cats that are more prone to abandonment are those that have behavioral problems, are acquired from shelters or at low cost, are six months old or older, are not neutered and have not attended obedience courses. The consequences of abandonment for animals are intrinsically related to sentience, manifested by physical suffering, such as hunger, pain and cold, as well as emotional suffering, including fear, loneliness and sadness (Barros, Gielfe, 2019).

Vulnerable dogs and cats face additional threats to their well-being and life expectancy, such as malnutrition and various environment-related diseases, including those caused by parasites. Human risks, such as mistreatment and brutal population control methods, also contribute to compromising the health and well-being of these animals. In addition, inadequate food and shelter conditions pose threats to human and environmental health when animals do not receive proper care (Barros, Gielfe, 2019).

According to Duarte *et al*. (2021), dogs and cats living on the streets lack medical care, resulting in a significant increase in aggression, often manifested as an act of defense. This can lead to accidents involving cyclists, motorcyclists and vehicle drivers. In addition, pedestrians passing near these animals run the risk of bites and scratches. It is important to note that retaliating against these animals is not an effective solution, as animal protection laws, although considered lenient, must be taken into consideration.

As established by the Environmental Crimes Law (Law No. 9.605, of February 12, 1998), those who commit mistreatment of animals can face a penalty of three months to one year in detention, in addition to being liable to a fine, which can be increased by one sixth to one third in the event of the animal's death (Brazil, 1998). In the case of crimes of lesser offensive potential, with sentences of up to two years, criminal proceedings may not be opened, and the punishment is usually converted into service.

In addition, failure to rescue dogs and cats in situations of serious and imminent danger can result in a sentence of one to three years' imprisonment (Moutinho *et al.*, 2015; Duarte *et al.,* 2021).

The rampant reproduction of these animals contributes significantly to their increased presence on the streets (Sampaio; Silva; Salan, 2009). Many people, responsible for these animals, adhere to myths related to castration, mistakenly believing that it causes physiological and behavioral changes and is synonymous with suffering and mutilation. Some consider mating at least once in a lifetime to be important, which results in a lack of control over reproduction, generating several litters of puppies (Duarte et al., 2021).

This scenario is aggravated by the lack of adoption capacity for all these puppies, since the animal population is growing exponentially. For every child born, approximately 15 dogs and 45 cats can be born. When these puppies are weaned, the struggle to find a home begins. Unfortunately, most of them do not get the homes they want and end up on the streets. Even when they are adopted, they are rarely neutered, which perpetuates the cycle of uncontrolled reproduction (Oliveira, 2016).

In addition to the social impact, this overpopulation of street animals also has serious environmental consequences. Uncontrolled population growth can lead to public health problems, competition for limited resources and negative impacts on local biodiversity. Therefore, the issue of street animals goes beyond social concerns and must be addressed considering its long-term environmental effects.

Several studies (Duarte *et al*., 2021; Barros & Gielfe, 2019; Miranda, 2018; Oliveira, 2016 and others) have investigated the impact of street animals, especially cats and dogs, on health and the environment.

The production of their food has been identified as a significant factor in global warming. Research in New Zealand has revealed that raising a medium-sized dog, feeding it well-known brands of dog food, results in an ecological footprint of 0.84 hectares per year, equivalent to the footprint of building and driving a rural van for 10,000 km. In the case of cats, this footprint is 0.15 hectares per year (Dourojeanni, 2015).

These figures, initially impressive, suggest that the 52 million dogs in the country may have an environmental impact as significant as pigs, sheep and goats. In addition, unleashed dogs, especially in Conservation Units close to urban areas, pose a serious threat to wildlife, hunting in packs and transmitting diseases. Cats, in turn, are recognized as major predators of wild birds, causing significant population declines (Dourojeanni, 2015).

The environmental impacts caused by unleashed dogs in urban areas are also notable, including the scattering of garbage, street litter, traffic accidents and bites to passers-by. Cats, driven by a predatory instinct, hunt for sport, which is not mitigated even by feeding them well.

Coase's theorem applied to solving the problems of street animals

The problem of stray animals is associated with various negative externalities, as already mentioned, which affect society, including risks to public health, environmental impacts and issues related to animal welfare. In this context, the application of the Coase Theorem proposes the efficient resolution of externalities through negotiation between the parties involved.

The first part is the government, which is responsible for establishing effective regulations relating to responsible ownership, population control and animal welfare. According to Almeida *et al*. (2014), the criminal approach adopted by the public authorities in most Brazilian municipalities results in a constant increase in the number of dogs and cats roaming the streets, subject to hunger, thirst, disease and mistreatment resulting from abandonment.

Public policies aimed to the control of the birth rate of street animals predominantly focus on comprehensive castration or sterilization programs. These initiatives aim to mitigate animal overpopulation, minimizing related problems such as abandonment and mistreatment. A common approach is to offer free or subsidized neutering services, especially aimed at street animals or low-income families (Tovo; Wilmsen, 2023).

The government plays a central role in developing and applying the One Health concept, taking responsibility for creating and implementing comprehensive policies that promote a sustainable balance between human, animal and environmental health. The drafting of effective regulations, investments in programs to prevent, detect and respond to health threats, as well as consistent oversight of these initiatives, are key elements under the government's responsibility. In adopting a One Health approach, the government should seek interdisciplinary collaboration and the active participation of society, promoting equity between different sectors and disciplines. The implementation of inclusive policies, which consider the diverse perspectives and voices of the community, is fundamental to the success of an integrated approach.

In addition, it is up to the government to allocate resources from taxes for public education programs, awareness-raising and practical interventions that address the interconnections between human, animal and environmental health. These actions aim not only to mitigate the risks of disease, but also to promote collective well-being and sustainability.

The second party involved is the population, which plays an active role in solving the problem by adopting responsible ownership practices, supporting sterilization initiatives and reporting cases of mistreatment.

Within the role of society, studies by (Osório, 2013; Jorge *et al*., 2018; Souza *et al.,* 2018) highlight the concept of responsible ownership. Within this field, there is an emphasis on the dependence of pets on their owners (Osório, 2011). Responsible ownership, in turn, implies a protocol that regulates various aspects of animals' lives, ranging from their nutrition and health to their mobility. This approach seems to be based on a contemporary paradigm in which science takes control and regulates nature. In this way, it is configured as a specific form of relationship between humans and animals, typical of the Western world, conceiving of human beings as controllers of the natural world, dissociated from it and holding responsibility for the preservation or extinction of species.

Continuing education, as highlighted in the studies by Almeida *et al*., 2014; Orlandi, 2014; Ribeiro *et al*., 2020, is vital to promote a change in people's mentality towards street animals. According to these authors, society still lacks knowledge about essential basic care and preventive measures ~~related to~~ animal health, which unfortunately contributes, albeit indirectly, to cases of mistreatment and abandonment of animals. Given this scenario, the importance of educational efforts in health becomes evident, especially the positive impact of these initiatives on the population.

The third party relies to companies of the *pet* sector, which can adopt ethical practices in their operations, avoiding the sale of animals from irresponsible breeders. They can also support adoption programs and promote products and services aimed at animal welfare.

On the following, we highlight the role of non-governmental organizations (NGOs) in the animal cause. NGOs play a key role in providing shelters, veterinary care and promoting adoption campaigns. They can collaborate with the government and society to implement effective programs.

These policies can be established with strategic partnerships with non-governmental organizations (NGOs) and veterinary clinics to carry out effective large-scale sterilization programs. The identification and registration of sterilized animals is also promoted, facilitating follow-up and interventions when necessary. In addition, punitive measures are implemented for those who practice abandonment, neglect or mistreatment, with the aim of strengthening animal protection laws.

It is worth noting that the Coase theorem seeks a negotiation between the parties involved to create synergies and comprehensively address the challenges associated with homeless animals. Effective collaboration among the government, the population, companies and NGOs is the key to a sustainable resolution of the negative externalities generated by this issue.

CONCLUSIONS

Faced with the complexity of the challenges presented by homeless animals, the One Health approach emerges as a valuable opportunity for building integrated and effective solutions. The Coase Theorem, applied to this problem, highlights the importance of negotiation between the parties involved - government, population, companies and NGOs - to improve the current Brazilian scenario.

The government, as the central piece in this puzzle, must take responsibility not only for creating effective regulations, but also for fostering interdisciplinary collaboration. The implementation of comprehensive policies aimed at responsible ownership, population control and animal welfare is fundamental. Promoting One Health requires the active participation of society, which in turn plays a crucial role in adopting responsible ownership practices, supporting sterilization initiatives and reporting cases of mistreatment.

Companies in the *pet* sector, aware of their impact, have the opportunity to adopt ethical practices and support adoption programs, contributing to building a more responsible community. Animal Non-Governmental Organizations, for their part, play a fundamental role by offering shelters, veterinary care and promoting adoption campaigns. Strategic collaboration between these sectors, encouraged by the Coase Theorem, is the key to a holistic approach.

Continuous education, which is essential for changing society's mentality towards street animals, is a powerful tool. Understanding basic care and preventative measures related to animal health are vital to mitigating cases of mistreatment and abandonment. One Health, when promoted in an inclusive way, considering diverse perspectives and voices from the community, becomes a powerful tool in managing this complex equation.

The opportunities for Cosean responses are vast and promising. Effective collaboration among government, the population, companies and NGOs is the key to a sustainable resolution of the negative externalities generated by street animals. By embracing One Health as an integrated approach, we can not only improve the quality of life of these animals, but also promote public health, mitigate environmental impacts and build a more conscious and compassionate society.

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